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The Engineer.

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Vol. CXXXV.—No. 3520] LONDON: FRIDAY EVENING, JUNE 15, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Assistant Engineers Required by the GOVERNMENT of CEYLON for Railway Construction, for three years' service, with possible extension. Salary £600, rising to £960 a year by annual increments of £30. Should the selected candidate be more than 30 the commencing salary will be £500 per annum. Free quarters or an allowance in lieu. Free passages provided. Candidates, unmarried, preferably between the age of 30 and 35, must be experienced engineers who have received good training and experience on a recognised European or American railway. Must have a thorough knowledge of surveying, levelling, estimating, setting out and supervising all works in connection with the location and construction of a railway. Members or Associate Members of the Institution of Civil Engineers preferred.

Apply at once by letter, stating age and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Ceylon 11,000. 2748

Ministry of Transport.
ROADS DEPARTMENT.
TEMPORARY ENGINEERS.

APPLICATIONS are INVITED for a number of TEMPORARY APPOINTMENTS as ENGINEERS at salaries of £400 to £500 per annum inclusive. These appointments are in connection with road schemes throughout England and Wales, and the majority of the appointments will be in the provinces. Practical and experienced men with knowledge of local administration and of modern road and bridge construction are required, and preference will be given to men who have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 4, Whitehall-gardens, S.W. 1. Applications can only be received on the prescribed forms and should reach the Ministry of Transport on or before the 23rd instant. 2747

In the High Court of Justice, Chancery Division. 1923. K. 041.
Mr. Justice Russell.
In the Matter of KITSON and CO. Limited and Reduced;
and
In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a PETITION for CONFIRMING a RESOLUTION REDUCING the CAPITAL of the above-named Company from £400,000 to £335,000 (the amount of such reduction being the sum of £65,000) was on the 1st day of May 1923 presented to the High Court of Justice and is now pending; and that the list of creditors of the Company is to be made out as for the 1st day of May 1923.

Dated this 12th day of June 1923.
VINCENT and VINCENT
20, Budge-row, London, E.C. 4
Agents for NORTH and SONS
4, East Parade, Leeds.
2753 Solicitors for the said Company.

In the High Court of Justice, Chancery Division. 1923. K. 041.
Mr. Justice Russell.
In the Matter of KITSON and CO., Limited and Reduced;
and
In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a PETITION for CONFIRMING the REDUCTION of CAPITAL of the above Company from £400,000 to £335,000 (the amount of such reduction being the sum of £65,000) was on the 1st day of May 1923 presented to the High Court of Justice and is now pending. A list of the persons admitted to have been creditors of the Company on the 1st day of May 1923 (the date fixed by the order in this matter dated 18th May 1923) may be inspected at the offices of the Company at the Airedale Foundry, Hunslet, Leeds or at the offices of the undersigned Solicitors and Agents at any time during usual business hours on payment of the charge of one shilling.

Any person who claims to have been on the said 1st May 1923 and still to be a creditor of the Company and who is not entered or the said list and claims to be so entered must on or before the 29th day of June 1923 send in his name and address and the particulars of his claim and the name and address of his solicitor (if any) to the undersigned North and Sons at 4 East Parade, Leeds, or in default thereof he will be precluded from objecting to the proposed reduction of capital.

Dated this 12th day of June 1923.
VINCENT and VINCENT,
20, Budge-row, London, E.C. 4,
Agents for NORTH and SONS,
4, East Parade, Leeds.
2753 Solicitors for the said Company.

UNIVERSITY OF DURHAM.

Armstrong College,
NEWCASTLE-UPON-TYNE.

LECTURER IN CIVIL ENGINEERING.

The Council of Armstrong College invite APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING. Candidates must be qualified to teach Surveying and have practical experience and a University Degree. Salary £350 to £400 per annum, according to qualifications. Duties to commence 1st October, 1923. Ten copies of applications and of not more than three testimonials should reach the undersigned not later than 7th July, 1923.

J. Y. T. GREIG,
Registrar.
2735 Armstrong College.

West Ham Municipal College,
ROMFORD-ROAD, STRATFORD, E. 15.

APPLICATIONS are INVITED for the POST of full-time ASSISTANT TEACHER in the Department of Engineering from candidates with University Degree and works experience. Salary in accordance with the Technical Burnham Scale for the London area, less 5 per cent., and subject to deduction for superannuation.

Forms of application may be obtained from the Principal, and should be returned not later than the 5th July, 1923.

GEO. E. HILLEARY,
2751 Town Clerk.

"THE ENGINEER" WANTED.

WANTED, COPIES of "THE ENGINEER" Dated
May 18th, 1917;
May 25th, 1917;
July 20th, 1917;
November 2nd, 1917.
Write to P1000, The Engineer Office. P1000

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Summer Meeting of the Institution of Electrical Engineers.

Science and Industry in Old Glasgow.

The Gas Turbine in Theory and Practice (No. VII).

Safety in Mines.

Chemical Engineers and their Training.

A New Type of Land Boiler.

Popular Knowledge.

The Operation of Water Gas Plant.

PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for ONE 8ft. and TWO 6ft. diameter PENSTOCKS complete with Operating Gear, for a Pumping Station now in course of erection at St. James'-street, Hammersmith, W. 6.

Persons desiring to submit Tenders may obtain, on and after Monday, 18th June, 1923, the drawings, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring Gardens, S.W. 1, upon payment of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specification and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 2nd July, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
2750 Clerk of the London County Council.

Borough of Guildford.
WATERWORKS EXTENSION.
NEW BORING AND TEST PUMPING.

The Corporation of Guildford invite TENDERS for CONSTRUCTING a SECOND BORING at their Joseph's-road Pumping Station, 400ft. deep, lined with 24in. tubes, and for TEST PUMPING from both borings.

Copies of the specification can be obtained on application to Mr. Percy Griffith, of 20, Victoria-street, S.W., or Mr. W. G. Cross, Borough Waterworks Engineer, Tuns Gate, Guildford, on payment of a deposit of Two Guineas, which will be returned to all firms sending bona fide Tenders.

Sealed Tenders, endorsed "Waterworks," are to be delivered to the undersigned not later than 4 p.m. on the 2nd day of July, 1923.

The Corporation do not bind themselves to accept the lowest or any Tender, and no order will be placed until the receipt of sanction from the Ministry of Health.

REG. C. KNIGHT,
Town Clerk.
Town Clerk's Office, Guildford,
9th June, 1923. 2726

City and County of Kingston-upon-Hull.
WATERWORKS.
DUNSWELL PUMPING STATION.
CONTRACT NO. 9.

The Water and Gas Committee of the Corporation of Kingston-upon-Hull invite TENDERS for the CONSTRUCTION of the UNDERGROUND WORKS required at the new pumping station at Dunswell, in the East Riding of Yorkshire.

The works consist of a Well and 17 Shafts sunk through drift into the chalk, 4600ft. of Adits driven horizontally in the chalk at a depth of 96ft. below O.D., and 8 Bores sunk to a depth of from 500ft. to 1000ft. The quantity of water to be raised from the workings during construction will probably exceed 15 million gallons a day.

The drawings may be inspected and specifications, schedule of quantities and form of Tender obtained on application to the undersigned. A deposit of Five Pounds in Bank of England or Treasury notes is required and will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Dunswell Works," are to be addressed to the Chairman of the Water and Gas Committee and delivered at the Town Clerk's office not later than Wednesday, 11th July, 1923.

By Order,
CHARLES B. NEWTON,
Engineer.
Guildhall, Hull,
7th June, 1923. 2616

PUBLIC NOTICES

City of Birmingham Water DEPARTMENT.

The Water Committee of the Corporation of the City of Birmingham is prepared to receive TENDERS from competent firms for the SINKING of a small number of 4in. diameter BORE-HOLES and GROUTING the same with Cement Grout under pressure, on the site of the proposed new reservoir at Frankley, near Birmingham.

Specification and form of Tender may be obtained at the Secretary's Office, Water Department, Council House, Birmingham, upon payment of the sum of £2, which amount will be refunded upon receipt of a bona fide Tender. Any further information that may be required with regard to details, &c., may be obtained from the Chief Engineer of the Water Department at his office, Springfield House, Ladlow.

Sealed Tenders, on the form provided for the purpose, addressed to the Secretary, Water Department, Council House, Birmingham, and endorsed "Frankley New Reservoir, Contract No. 7," should be delivered at the Secretary's office on or before Noon on Monday, 25th June, 1923.

The Water Committee does not bind itself to accept the lowest or any Tender.

J. H. BROADLEY,
Secretary.
Water Department,
Council House, Birmingham,
29th May, 1923. 2656

City of Birmingham.

TENDERS FOR THE INSTALLATION OF ELECTRIC LIGHTING AND FOR THE SUPPLY AND ERECTION OF TWO FIVE-WIRE BALANCER SETS.

The Salvage and Stables Committee invite TENDERS as follows:—

FOR THE SALVAGE WORKS NOW BEING ERECTED AT BROOKVALE-ROAD, WITTON.
CONTRACT NO. 1.—The INSTALLATION of ELECTRIC LIGHTING.
CONTRACT NO. 2.—SUPPLY and ERECTION of ONE FIVE-WIRE BALANCER SET.

FOR THE MONTAGUE-STREET DESTRUCTOR WORKS.
CONTRACT NO. 3.—SUPPLY and ERECTION of ONE FIVE-WIRE BALANCER SET.

Plans and general conditions of contract (which include the Corporation's usual provisions as to labour and fair wages), may be seen, and copies of the specification and other particulars obtained, upon application to Mr. James Jackson, Superintendent, Salvage Department, 161, Corporation-street, Birmingham, on payment of a deposit of £1 1s., which will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Contract No. ——," must be delivered at the offices of the Superintendent of the Salvage Department not later than Twelve Noon on July 2nd, 1923.

The Committee do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to divide the contracts and contract with two or more contractors.

Contractors must state whether they have adopted the Government scheme relating to the employment of disabled ex-Service men.

F. H. C. WILTSHIRE,
Town Clerk.
The Council House, Birmingham,
June 11th, 1923. 2730

Metropolitan Borough of ISLINGTON.

The Cleansing Committee invite TENDERS for the PURCHASE of a 3½ H.P. CROSSLEY GAS ENGINE at Liverpool-road Depot, N. 1. The engine is used for driving the chaff-cutting machinery, &c., and may be seen at work by arrangement with the Cleansing Superintendent, Liverpool-road Depot, N. 1.

Tenders, endorsed "Tenders for Purchase of Gas Engine," should be delivered to the undersigned not later than Noon on Tuesday, 31th June, 1923.

By Order,
C. G. E. FLETCHER,
Town Clerk.
Islington Municipal Offices,
Tyndale-place, N. 1. 2749

PUBLIC NOTICES

Government of Mysore.

TENDERS are INVITED for the SUPPLY of:—
12,640 FEET of 16in. STEEL PIPING.
The specification and form of Tender may be obtained at the address given below on payment of 10s. 6d. (which is not returnable).
Tenders must be sent in to the same address not later than Noon on Friday, 22nd June, and clearly marked "Tender for Steel Piping."
The Government do not bind themselves to accept the lowest or any Tender.
Mysore Government Office,
Sentinel House,
Southampton-row, W.C. 1. 2764

Sevenoaks Rural District COUNCIL.
EDENBRIDGE SEWAGE DISPOSAL WORKS.
CONTRACT NO. 1.
TO CONTRACTORS.

The Rural District Council of Sevenoaks are prepared to receive TENDERS for the CONSTRUCTION of the following WORKS:—

The ERECTION of an ENGINE-HOUSE; the CONSTRUCTION of a CAST IRON PUMPING MAIN, SEDIMENTATION TANKS, SLUDGE DRAIN, SLUDGE BEDS, and other WORKS; the CONSTRUCTION of CARRIERS and the LAYING OUT an AREA of LAND for IRRIGATION PURPOSES;

all in accordance with the specification and drawings prepared by Mr. G. Midgley Taylor, Civil Engineer, of the firm of John Taylor and Sons, 36, Victoria-street, Westminster, S.W. 1.

Copies of the specification and bill of quantities with form of Tender may be obtained and the drawings inspected at the offices of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Tenders, endorsed "Edenbridge Sewage Disposal," must be delivered in a sealed package, addressed to the undersigned, at the office of the Rural District Council, Sevenoaks, before 10 a.m. on Wednesday, the 4th day of July, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
(Signed) F. H. VIBERT,
Clerk to the Council.
Rural District Council Office,
Sevenoaks,
June, 1923. 2720

St. Pancras Borough Council.
ELECTRICITY DEPARTMENT.
CONDENSING WATER MAIN.

TENDERS are INVITED for the SUPPLYING and LAYING complete of about 100 YARDS of 36in. CAST IRON SOCKET and SPIGOT PIPES with REINFORCED CONCRETE OUTLET into the Regent's Canal.

Drawings can be seen and specifications can be obtained on the payment of One Guinea at the offices, 57, Pratt-street, Camden Town.

Tenders to be delivered to the undersigned by Noon on Thursday, July 19th, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

C. H. F. BARRETT,
Town Clerk.
9th June, 1923. 2721

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—
1. FISH BOLTS, SPIKES, &c.
2. SWITCHES and CROSSINGS and SPARE PARTS (Metre Gauge).
3. STEEL FISH-PLATES (Special Pattern).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Fish Bolts, Spikes, &c.," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 29th June, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1 and 2 and of 5s. for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
8th June, 1923. 2719

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PUBLIC NOTICES

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

(a) 1000 BUFFERS, &c., for CARRIAGES and WAGONS ;
(b) 400 TYRES, &c., for CARRIAGES and WAGONS ;
(c) 246 TYRES, &c., for LOCOMOTIVES ;
(d) MILD STEEL ANGLES, PLATES, &c.;

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Buffers, &c.," or as the case may be, are to be lodged not later than Noon on Friday, the 6th day of July, 1923.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
6th June, 1923. 2716

Municipal Corporation of RANGOON.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT WATER and SEWERAGE ENGINEER to the Municipal Corporation of Rangoon.

AGE.—Preferably between 30 and 35 years.

QUALIFICATIONS.—Candidates should hold one of the following qualifications :—

Associate Member of the Institution of Civil Engineers or a degree in engineering of any University recognised by the Institution of Civil Engineers as exempting candidates from entrance examination for associate membership.

EXPERIENCE.—It is essential that candidates should have had considerable experience in the design, construction and management of works of water supply, including that of heavy pumping machinery, sewerage systems with tidal and other outfalls, and sewage disposal works. It is also desirable that candidates should have had experience in the general administration of a Municipal Engineer's office.

SALARY.—The grade of the appointment is fixed at Rs. 500 per mensem, rising by annual increments of Rs. 50 per mensem to Rs. 1000 per mensem, in addition an overseas allowance of Rs. 150 per mensem and motor car allowance of Rs. 150 per mensem. The Corporation are prepared to advance, if desired, a sum equal to four months' salary to assist in the purchase of a motor car. The initial salary of the appointment may be fixed up to a maximum of Rs. 1000 per mensem, plus Rs. 800 on account of motor car and overseas allowances in accordance with experience and further qualifications. Other things being equal, preference will be given for approved war service.

AGREEMENT.—The gentleman appointed will be required to pass a medical examination by a doctor nominated by the Corporation and to enter into an agreement in the first case for a period of five years, subject to a probationary period of one year included in the foregoing period. During the probationary year three months' notice terminating the appointment may be given and received. Full first-class passage to Rangoon by Bibby Line will be paid and half salary during passage and similar passage paid if leaving Rangoon within three months of satisfactory termination of appointment. Leave and leave allowances in accordance with the Indian Service leave rules of the Government of India.

The officer appointed will be eligible to subscribe to the Municipal Provident Fund after being confirmed in his appointment ; subscriptions are payable at the rate of 8 1-3 per cent. of salary and an equal amount is contributed by the Corporation. Compound interest is allowed according to the amount earned by the Fund, usually 5 per cent. No exchange compensation allowance will be allowed.

Applications, stating age, qualifications, list of appointments held, together with the salaries thereof, if employed, whether married or single, and accompanied by copies of not more than three recent testimonials, will be received up to Noon on the 28th of July, 1923, by the undersigned, from whom further particulars may be obtained.

OGILVY GILLANDERS and CO.,
Agents to the Municipal Corporation of Rangoon.
Reference R. 2216.
2746 67, Cornhill, London, E.C. 3.

Surrey County Council.

HIGHWAYS AND BRIDGES DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of a FIRST ASSISTANT ENGINEER, who is required to be a corporate member of the Institution of Civil Engineers, to have had a thorough experience in surveying, preparation of drawings, specifications, and quantities for Road and Bridge Construction, and in the Repair of Roads, particularly in the use of asphaltic materials, and not over 40 years of age.

The appointment will be ranked as an officer of the third class, carrying a salary commencing at £395 per annum, rising by annual increment, subject to approved service, of £15 to £500, and will be an established post under the Council's Superannuation Scheme. It will be determinable at the pleasure of the Council at three months' notice in writing on either side, and be subject to the Standing Orders of the Council relating to whole-time duty, travelling and subsistence allowances and other conditions of the service.

Applications should be forwarded to the County Surveyor at the underwritten address on or before the 28th day of June, 1923.

T. W. WEEDING,
Clerk of the Council.

County Hall, Kingston-upon-Thames.
June, 1923. 2765

SITUATIONS OPEN

WANTED, ASSISTANT, Qualified to Survey Large Factory Establishment Lay-out Dimension and Estimate Capital Cost of Installing and Operating Expenses of Heating Plant for Building and Process Heating on low-pressure feed with vacuum return system. Experience, qualifications, and wage expected. —Address, "HEATING," Wm. Porteous and Co., Advertising Agents, Glasgow. P7574 A

WANTED for Calcutta, a Good All-round MECHANICAL ENGINEER, with practical experience in Steam and Pumping Engines. Must be well educated. Age not to exceed 30, unmarried ; 5-year agreement.—Reply in writing to Messrs. ALEX. LAWRIE and CO., 14, St. Mary Axe, E.C. 3. 2602 A

ASSISTANT CIVIL ENGINEER DRAUGHTSMAN REQUIRED for Chilian Railway. Must be single. Preference given to candidates with railway experience and knowledge of Surveying. Salary to commence, £300 per annum, with free quarters. Three years' contract, free passage out and home and half-pay and £10 for expenses on the outward journey.—Write, with full particulars, to "J. E.," c/o Charles Barker and Sons, Ltd., 31, Poultry, E.C. 4. 2745 A

ASSISTANT REQUIRED in Water Engineer's Office for waterworks on South Coast of England. Must be a good Surveyor, Leveller and Draughtsman, possessing technical knowledge and have had experience in Distribution Department. Age about 25.—Write, giving full particulars and salary required, to Z. M. N. O., care Deacon's, Leadenhall-street, E.C. 3. 2704 A

CHIEF ENGINEER REQUIRED for Large Chocolate and Food Producing Works near London. Only experienced men with good electrical and mechanical qualifications need apply.

State full particulars, including age and salary required.—Address, 2717, The Engineer Office. 2717 A

ELECTRICAL ENGINEER. Young, Single, WANTED for South of Europe. Good theoretical training essential and some practical experience since finishing education. Modern Power-house Experience preferred.—Write, stating age, particulars of training, details of experience, salary required, languages spoken, to "E. S.," c/o Street's, 30, Cornhill, E.C. 3. 2708 A

ENGINEER, with Practical and Theoretical Experience and knowledge of Steam Generating and Factory Plant, to Instruct Operators and Introduce Economical Methods. Man without this preferred, as the work involves continually travelling the country. State full particulars and salary expected.—Address, 2749, The Engineer Office. 2749 A

A REAL ROMANCE OF INDUSTRY.

ALFRED YARROW :

HIS LIFE AND WORK.

By ELEANOR C. BARNES (Lady Yarrow).

With many Coloured and other Illustrations. 10s. 6d. net.

London : EDWARD ARNOLD & CO., 41 and 43, Maddox Street, W. 1.

SITUATIONS OPEN (continued)

METALLURGIST.—CHIEF ASSISTANT WANTED for Engineering Works. Thorough training in Chemistry and Metallurgy essential, with practical experience of Iron and Bronze Foundry Practice.—Give full particulars, together with age and salary required, to ALFRED HERBERT, Ltd., Edgwick Works, Pelehill, Coventry. 2667 A

METALLURGIST WANTED for Responsible Position. Preference will be given to applicant having Works Experience and ability to Carry Out Original Investigation.—Address, stating briefly experience and qualifications, 2733, The Engineer Office. 2733 A

PUBLICITY.—ENGINEERING FIRM in Manchester REQUIRES the SERVICES of a GENTLEMAN to COMPILE CATALOGUES ; also to Control Advertising and Propaganda Work.—Address, full particulars and salary, 2759, The Engineer Office. 2759 A

PULVERISED COAL PLANT ; SALES ENGINEER.—REQUIRED, the SERVICES of a GENTLEMAN of good education and address, with theoretical and practical knowledge of Power Plants and Furnace Work, to SELL PULVERISED COAL PLANT.—Address, stating age with full particulars of training and experience, 2757, The Engineer Office. 2757 A

REPRESENTATIVE REQUIRED for the Midlands ; also REPRESENTATIVE for South Wales. Must have influential connections and very best references for ability and personal character. Applicants should give full details, which would be treated in strict confidence.—Address, SECRETARY, George Cradock and Co., Ltd., Wire Rope Works, Wakefield. 2762 A

THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., 1, Dickinson-street, Manchester, REQUIRE the SERVICES of a High-class SALESMAN with a knowledge of Reinforced Concrete on Constructional Engineering, to represent them in certain Northern counties. Travelling experience not essential, but will carry preference. Replies, marked "Confidential," should state age, qualifications, and salary required.—Address, 2723, The Engineer Office. 2723 A

WANTED, DESIGNER DRAUGHTSMAN, with experience in Steel Constructional Designing, also Elevating and Conveying of Minerals, Grain, &c. —Address, stating age, experience, and salary required, 2709, The Engineer Office. 2709 A

DRAUGHTSMAN REQUIRED Experienced in manufacture and estimating Mechanical and Electrical Railway Signal Work. London district.—Address, giving full details of experience, 2729, The Engineer Office. 2729 A

DRAUGHTSMEN, Railway Carriage and Wagon.—Apply (letter only), stating age, experience, and salary, METROPOLITAN CARRIAGE CO., Saltley, Birmingham. 2732 A

DRAUGHTSMEN WANTED, with Thorough Knowledge of the Design of Large Locomotive Steam Cranes. State age, experience, salary required, and when at liberty.—Address, 2728, The Engineer Office. 2728 A

FRENCH-SPEAKING MECHANICAL DRAUGHTSMAN WANTED for position in Canada. Knowledge of Engineering Mathematics necessary as well as skill in Drawing.—Address, with qualification particulars, 2561, The Engineer Office. 2561 A

LEADING DRAUGHTSMAN.—WANTED, for a Railway in Chile, a thoroughly competent LEADING DRAUGHTSMAN, with sufficient locomotive experience to in due course take up position of Assistant Locomotive Superintendent. Unmarried man preferred, age about 30. Salary £35 per month, with living allowance and residence. Four years' engagement. First-class passage out and home on completion of contract.—Address, giving full particulars of experience, with copies of testimonials, to "L. D.," c/o Street's, 30, Cornhill, E.C. 3. 2713 A

MECHANICAL DRAUGHTSMAN, Experienced, WANTED for general work, London area. Salary £6.—Address, stating age, experience, &c., 2714, The Engineer Office. 2714 A

REQUIRED, SENIOR and JUNIOR DRAUGHTSMEN ; first-class experience essential ; used to Design of Front and Rear Axles.—State age, experience, and salary required to KIRKSTALL FORGE, Ltd., Leeds. 2744 A

WANTED, FOREMAN, Experienced in the Manufacture of High-class Balls for Ball Bearings. State experience and salary. First-class man wanted. —Write, Box 2851, Willing's, 20, King-street, Covent Garden, W.C. 2. 2671 A

FOREMAN BOILERMAKER WANTED ; Must be thoroughly conversant with all sections of Lancashire Boiler construction. State experience, age, salary, &c., in confidence.—Address, 2745, The Engineer Office. 2745 A

FOREMAN SMITH REQUIRED : Must be Fully conversant with Railway Carriage and Wagon Work and able to take out estimates. Only really qualified men will be considered.—Apply in writing only to the GENERAL MANAGER, Midland Railway Carriage and Wagon Co., Ltd., Washwood Heath, Birmingham. 2722 A

FOREMAN, with Extensive Experience in Well and Trial Hole Borings, REQUIRED for about 9 months at Singapore.—Write, stating age, experience (at home and abroad), salary required, and full particulars, with copies of not more than three testimonials, to Box No. 853, c/o White's, 38, Fleet-street, London, E.C. 4. 2710 A

GENERAL FOREMAN REQUIRED for Public Works, Harbour Works, Quarrying, Building, &c. : 200 workmen employed.—Reply, stating age, experience, salary, and references, to RESIDENT ENGINEER, Laverburgh, Isle of Harris. P7608 A

THE SAN PAULO RAILWAY COMPANY in Brazil REQUIRES the IMMEDIATE SERVICES of a thoroughly competent and practical man as BRIDGE FOREMAN to Take Charge of the Erection and Maintenance of Steel Structures. Married man preferred, age not over 40. Free quarters provided. Salary 800 milreis per month.—Apply by letter, giving full particulars of experience, &c., to FOX and MAYO, Consulting Engineers, 155, Dashwood House, New Broad-street, London, E.C. 2. 2735 A

IRON and BRASSFOUNDERS, DO NOT MISS POSITIONS ADVERTISED. The "Foundryman's Educator" will give you confidence on mixings, meltings, and proportions. Post 2s. Highest of testimonials.—GREAVES, Harewood Hall, Heywood, Lancs. P7607 A

SITUATIONS WANTED

WANTED by Man, Aged 37, POSITION in Charge of Constructional or Maintenance Work ; well up in reinforced and mass concrete, furnace building, and ordinary brickwork. Just completed large job in the East. Good refs., total abstainer ; no objection to going abroad.—F., 46, St. Paul's-road, Thornton Heath. P7586 B

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Science and Industry in Old Glasgow.

THE rise and decline of towns and cities is of no less interest than that of the rise and decline of nations, and at the forthcoming visit of the Institution of Mechanical Engineers to Glasgow the members will see a city that has in the course of the last 120 years multiplied twelve times. In 1801 the population of Glasgow was about 84,000, whereas to-day it is more than a million. During the same period the population of the whole kingdom has increased but three times. Chief among the causes for this wonderful development must be placed the enterprise of its citizens, its geographical position and its reputation as a seat of learning. During the last century it has been in the van of scientific education and, as Lord Kelvin reminded us in 1904, Glasgow had the first laboratory for the instruction of students in practical chemistry, it established the first chair of engineering in the British Empire, and, thanks to the generosity of the widow of the great marine engineer, John Elder, it was enabled to found the first university professorship of naval architecture. Of later years nothing has added more to the true greatness of the city than the important part played by those who have passed through the halls and the laboratories of its University. When London University was founded in 1828, that of Glasgow had been in existence nearly 400 years. It was the second of the Scottish Universities. St. Andrews was founded in 1411, Glasgow in 1450, Aberdeen in 1494, and Edinburgh in 1582. In 1450 Glasgow, though enjoying the status of a burgh, was but a small cathedral town with Bishop Turnbull at its head. Judged suitable for a seat of learning "by reason of the healthiness of its climate, the plenty of victuals, and of everything needful for the use of men," it was formed on the model of the great school at Bologna; but for all that "it came into the world as naked as any individual," as a college historian declares. Professors and students alike were desperately poor and the buildings neglected. The Reformation left it poorer than ever, but the appointment of that universal scholar, Andrew Melville, as its head speedily led to its taking a high place in the scholastic world, so that Melville's nephew could write, "there was no place in Europe comparable to Glasgow for guid letters during these years, and for guid, plentiful, and cheap mercat of all kinds of languages, arts, and sciences."

The fine range of buildings in which the University is now housed is its third home. Originally it occupied an old building in the Rotten Row, the ruins of which were still standing in the eighteenth century. The College in which Maclaurin studied and Watt kept his shop and in which Kelvin and his father lectured was begun in 1631. It was a sombre-looking building, situated in the High-street leading up to the cathedral. It is more than fifty years since this was sold to the railway authorities, having stood for nearly two and a-half centuries. A cellar under the old College was Kelvin's first laboratory, and here Sir William Ramsay was introduced to the routine of the laboratory by spending his first week taking kinks out of a coil of copper wire. It is strange to-day to read that when the College was being erected the timber from Norway and the iron from Sweden was landed at Irvine or Dumbarton and conveyed to Glasgow on sledges. Life in the old University, whether under presbytery or prelacy, was strict and frugal. Prayers and the reading of Scripture by candle light began at 6 a.m., and short meals and long graces were the order of the day. Nothing but Latin was spoken, and up to 1726 one professor took all subjects, whether it was Greek, mathematics, logic, moral philosophy, or pneumatics—which included the nature of spirits, angels and deity. Sunday was a day of awful solemnity both in College and in town. At the beginning of the eighteenth century there were 400 students, a number not exceeded for sixty years. It was not, however, till after the final suppression of the Stuarts in 1745–46 that Scotland began really to enjoy the privileges of peace, and it was the period immediately after this that saw the pioneering work in the University of Cullen, who introduced the study of chemistry, and of Black, Adam Smith, Watt, Robison, and others.

First among Glasgow mathematicians to achieve more than a local reputation was Robert Simson, who was born in 1687, the year Newton published his "Principia." Son of the professor of divinity, a meeting with Halley in London led to him making a lifelong study of the old Greek geometers. Practically every schoolboy owes something to Simson, for nearly all editions of Euclid are based on his work. He held the chair of mathematics at Glasgow from 1711 to 1761. Among his students was Maclaurin. Sent at the age of eleven to prepare for the Church, when twelve, Maclaurin, like Pascal, gained possession of a copy of Euclid, and that determined his career. He ultimately became professor at Edinburgh and died at an early age through his efforts to defend the city against the rebels of '45. Chemistry was first taught at Glasgow by the learned Cullen, professor of medicine. Black was his pupil and assistant, but Black graduated at Edinburgh, and it was there his thesis was published containing his great discovery of carbonic acid gas or fixed air, as he called it. Cullen removed to Edinburgh in 1756, Black succeeded to his chair at Glasgow, and about the same time Watt settled there after his year in Morgan's shop in London. Black's discovery of the doctrine of latent heat and Watt's invention of the separate condenser were made almost simultaneously. Black taught his theory in 1763, while Watt's flash of inspiration came one day in 1765. He had gone to take a walk on a fine Sunday afternoon early in 1765. "I was thinking," he wrote, "upon the engine at the time, and had gone as far as the herd's house, when the idea came into my mind that as steam was an elastic body it would rush into a vacuum, and if a communication were made between the cylinder and an exhausted vessel it would rush into it, and might be there condensed without cooling the cylinder. I then saw that I must get rid of the condensed steam and injection water if I used a jet as in Newcomen's engine. . . . I had not walked farther than the golf-house when the whole thing was arranged in my mind."

Other scientific worthies of this time were Alexander Wilson, the successful typefounder, who became the first professor of astronomy and left a thousand pounds to buy instruments; John Anderson, professor of natural philosophy for forty years and the founder of the Andersonian Institution; John Robison, the lifelong friend of Watt and the successor to Black as teacher of chemistry in the University, and also the young student of divinity, Melville, who, with Wilson, observed the temperature of the upper air by means of kites, and in 1752 described his pioneering experiments on the study of coloured flames by the prism. Melville died at Geneva in 1753, at the early age of twenty-seven. William Irvine, who assisted Black in his heat experiments, and Hope, the discoverer of the maximum density of water, were both successors to Black and Robison in the chair of chemistry. Hope's main work was, however, done at Edinburgh. It was once estimated that no fewer than 16,800 students had attended his lectures.

More than a passing mention is due to Anderson, who bequeathed everything he had for the benefit of the artisans of Glasgow, for to him we owe the mechanics' institutions, which were the forerunners of our technical schools and colleges. Anderson died in 1796, and the same year the Andersonian Institution was opened with lectures by Thomas Garnett as professor of natural philosophy. A professor of mathematics was appointed in 1799, and the same year, on Garnett going to the Royal Institution of London, Birkbeck took his place. In 1800 Birkbeck started a class "solely for persons engaged in the exercise of the mechanical arts, men whose education in early life has precluded even the possibility of acquiring the smallest portion of scientific knowledge." From this, in after years, sprang the Glasgow Mechanics' Institute, and the Birkbeck College in London was also due to the same enlightened man. Birkbeck left Glasgow for London in 1804 and was succeeded by another medical man, Andrew Ure, who also lectured to the artisans of Glasgow, and through a report on his plans by Baron Dupin, similar lectures were inaugurated at the Ecole des Arts et Métiers in Paris. After Ure came the famous chemist, Thomas Graham, whose statue was erected in Glasgow by James Young, the originator of the paraffin industry. Anderson's College, in 1886, was, with five other institutions, incorporated in the Glasgow and West of Scotland Technical College, known since 1912 as the Royal Technical College. Space does not permit of more than the mention of some of the eminent men of science who have made Glasgow famous during the last century. For many years the chair of chemistry in the University was held by Thomas Thomson, who first made public Dalton's atomic theory and who established a laboratory for students. From 1832 till 1849 the chair of mathematics was held by James Thomson, the father of Lord Kelvin. His contemporaries included Meikleham, the natural philosopher, and Nichol, the astronomer. The chair of engineering was founded in 1840 and was held by Lewis Gordon till 1855, when he resigned and was succeeded by Rankine. Gordon had been one of Brunel's assistants on the Thames Tunnel. Of Rankine it has been said that he was probably the most original thinker who ever occupied an engineering chair at a British University, his only possible rival being his successor, James Thomson. The chair of naval architecture dates from 1883, when Elgar became the first occupant.

Glasgow was one of the first cities to feel the effects of the industrial revolution brought about by the inventions of Watt and Arkwright, the discoveries of the French and British chemists, and the improvements in the manufacture of iron. The Carron Works near Falkirk were established in 1760, but up to 1772 imported iron was used on the Clyde for manufacture and export. The earliest important factories in Scotland date from 1777. In 1786 Dale established cotton spinning works near Lanark. In these there were no fewer than 795 boys and girls employed, of whom 523 were under fourteen years of age and nearly 300 were between six and ten. These unfortunate children were in the factory at 6 a.m. and stayed there till 7 p.m. Glasgow stood greatly in need of improvement. Up to 1777 Glasgow streets were unpaved; in 1790 there were still no sewers; a filtered water supply from the Clyde was not available till 1806. In 1755 Watt had taken nearly a fortnight to get to London, and the mails were for long after this carried by boys on horseback. Stage coaches began running in 1788. The first Act for the improvement of the river was passed in 1759, but little was done till the steam dredger made its appearance. Over ten millions have been spent on widening and deepening the Clyde, which could at one time be forded many miles below Glasgow. But even forty years ago a French observer wrote: "Nowhere as at Glasgow is there revealed in such luminous traits all that can be done by the efforts of man, combined with patience, energy, courage and perseverance, to assist Nature, and, if necessary, to correct her. To widen and deepen a river previously rebellious against carrying boats; to turn it into a great maritime canal; to bring the waters where it was necessary to bring the largest ships; and finally, to gather a population of 750,000 inhabitants, all devoted to commerce and industry, upon a spot where only yesterday there was but a modest little town, almost destitute of every species of traffic—such is the miracle which in less than a century men have performed at Glasgow."

In the factors contributing to the phenomena development referred to by the French engineer, Simonin, a foremost place must be given to the share Glasgow and the neighbourhood has taken in the growth of the steamship. Bell's little Comet of 1812 was built at Port Glasgow, but her engine was made by Robertson in the city, as also was the boiler, which was constructed for her by that great pioneer, David Napier. It is exactly 100 years ago since Robert Napier made his first marine engine, the one that is preserved at Dumbarton Castle. At that time there were but 111 steamboats owned in the whole of the British Empire, and their total tonnage was but equal to the tonnage of a good-sized tramp of to-day. Now the work of the Napiers, the Scotts, the Dennys, the Elders, the Thomsons, and scores of others have lined the banks of the river with docks and wharves, slips and workshops, from which ships like the Aquitania and the Hood are launched and fitted out. Here is to be seen one of the results of that blending of science and industry by which life has been revolutionised. A steamship, after all, is but an epitome of all the arts and the sciences embodying the discoveries of the mathematician at his desk, the chemist in his laboratory, the metallurgist in his foundry, and the mechanician in his workshop.

Institution of Electrical Engineers.

No. II.*

THOSE who took part in the Institution of Electrical Engineers' summer meeting had no reason to complain about anything save the dull and somewhat chilly weather. In Manchester alone many works and other places of interest, such as the laboratories of Manchester University, &c., were open for inspection, and, from an educational point of view, the trip was of exceptional value. Much credit is due to the members of the Manchester and Liverpool local centres who undertook the work of organising the outing, for their task must have been very far from a light one. The fact that no papers were read did not make the meeting less interesting than those that have been held in the past. Indeed, if the number of participants is anything to go by, the absence of papers is not regarded as a detriment to summer meetings. But with so many invitations to inspect works, power stations, universities and technical colleges, not a few of the visitors must have experienced difficulty in mapping out their programme. No single individual could take part in all the trips that were arranged, or even form a very accurate idea of the hospitality which was extended to the Institution as a whole. Many of the concerns which invited the members to inspect their works did everything in their power to instruct and cheer their guests, and much time must have been spent in preparing for the visits. In common with others we ourselves were unable to see everything, and if our articles on the meeting appear incomplete, this fact and limitations of space are alone responsible.

MATHER AND PLATT'S WORKS, NEWTON HEATH.

Very considerable extensions of their works at Newton Heath, Manchester, have been made during the last few years by Mather and Platt, Limited. The first step in the erection of the present buildings was taken in 1900 on a site measuring 50 acres alongside, and with direct access to, the Lancashire and Yorkshire Railway—now incorporated into the London, Midland and Scottish Railway—when an administration building, two storeys high, shown at the extreme left-hand side of the plan, Fig. 5, was erected. For the first machine shop the Machinery Annexe of the Paris Exhibition of 1900 was purchased. It was pulled down by Mather and Platt's own staff, shipped to Manchester *viâ* the Ship Canal and re-erected. This shop is 376ft. long by 130ft. wide and is now used for the manufacture of pumps, valves, &c., in connection with the fire-extinguishing section of the firm's activities, as well as for a general stamping department for the whole of the works.

* No. I. appeared June 8th.

With the steady and constant growth of the firm's manufactures additional buildings were erected in 1903, 1905, and 1909, when increased space was provided for the electrical engineering department by the construction of two more machine shops, each 376ft. long by 40ft. wide. It was decided in 1909 to make provision for the removal of all remaining departments from the original works in Salford, and in 1910 seven more shops, 376ft. long, with bays 52ft. by 40ft. wide, were constructed. The demand for space still continuing, further extensions became imperative, and in 1913 a new wing of four bays at the extreme right-hand end of the block shown in Fig. 5 was erected. This wing measures 439ft. long

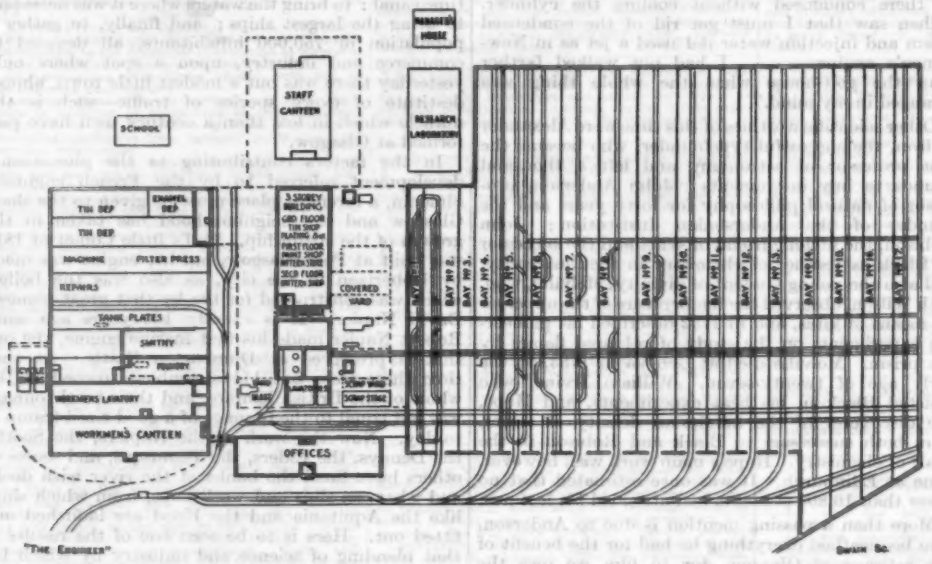


FIG. 5—PLAN OF THE WORKS AT NEWTON HEATH OF MATHER AND PLATT, LTD.

by 161ft. wide. It was fortunately completed just prior to the outbreak of war in 1914 and was let for the subsequent period of the war to A. V. Roe and Co., Limited, for the manufacture of aeroplanes for fighting purposes. The two-storeyed building shown on the extreme bottom left-hand corner of the plan had been erected in 1911. It is 218ft. long by 48ft. 6in. wide, and the first floor is used for administration purposes, while the ground floor is made use of for a dining-room to accommodate 1000 men. Adjoining it is a well equipped cloak room and lavatory with supplies of hot and cold water.

At the rear of the central administration block there is a three-storey brick building with floor and roof of reinforced concrete, in which are centralised all the processes of manufacture that are regarded, for insurance purposes, as hazardous. For example, the ground floor is utilised partly in the preparation of cotton for the bowls of textile machinery and partly as a coppersmiths' and sheet metal shop. The first floor is used as a pattern stores and the second floor as a patternmaking shop. Another large building, measuring 275ft. by 218ft., comprises the brass-foundry, smiths' shop, grinding shop and departments for the production of chemical fire-extinguishing apparatus and cast iron sectional tanks. The latest development in building is the lengthening of the fourteen bays by an additional 178ft. and the building of a research laboratory, as shown on the plan, Fig. 5.

All departments of the works, covering about 20 acres, are well served by transport facilities. A line of standard-gauge runs from Mather and Platt's own siding on the London, Midland and Scottish Railway, and there are branches into all the various departments, so that raw materials and finished products can be unloaded and loaded direct from and into the railway trucks, thereby saving unnecessary handling. After trying various systems of truck haulage, the use of a battery electric locomotive was found to give the best results, and is now exclusively used to connect the works with the main line. Further, a complete system of narrow-gauge tramway lines—21½in. gauge—is laid in each bay, and trucks capable of carrying 2 tons are employed to convey goods from one department to another. The trucks run on roller bearings and can easily be pushed about by one man. Small battery electric trucks are also being used with success in the shops. Most of the bays are served from end to end by fast-running overhead electric cranes, some bays being provided with three cranes. The average height under these cranes is 24ft. In addition, pneumatic hoists and jib cranes, operated by hand, are placed over the benches. The larger machine tools are driven independently by their own electric motors, and the lighter tools are operated from sections of overhead line shafting, each section being driven by its own motor.

The offices and shops are fitted with a model fire-extinguishing plant. This includes some 6000 Grinnell sprinklers divided into thirteen distinct installations, each controlled by a separate set of 6in. alternate wet and dry pipe valves. The water supplies are two separate 8in. connections from the Corporation mains, a gravity tank of 10,000 gals. capacity, and an electrically driven turbine pump automatically controlled and capable of delivering 1000 gals. of water per minute. This pump is also connected to a 6in. hydrant main to feed hose pipes and jets through hydrant valves distributed in advantageous positions all over the works. Chemical extincteurs and water buckets are also provided for immediate use in case of fire.

The ventilation and heating systems have been well designed. For heating low-pressure steam is used, each bay having its own battery of heating pipes running the full length. The steam is produced by four vertical tubular boilers, each having 850 square feet of heating surface. The resulting water of condensation from the heating system is exhausted by vacuum pumps, a partial vacuum being maintained in the return mains. The condensation water is delivered into a tank near the boilers and pumped back into the boilers, so that little heat is lost. In this heating installation there are 22 miles of piping from 6in. down to 1¼in. diameter. A temperature of 55 deg. to 58 deg. is maintained in the works, as it has been found to be the best average temperatures for comfortable working conditions.

The new electrical test bed is situated at the end of the new extensions and is spread across three bays, and an uninterrupted passage is provided at the front to give a clear view along the whole length of the switchboard. Each of the three sections of the test bed is self-contained, but a system of interconnecting mains permits machines of a non-standard character to be tested anywhere without unnecessary duplication of plant.

Ample power supply of three-phase, 50-cycle current is obtained from the Manchester Corporation mains, carried by an underground feeder from the sub-station to the test bed. The equipment includes four static transformers of a normal capacity of respectively 150, 300, 500, and 700 kilovolt-amperes. Each transformer is provided with tappings and, in the case of the larger sizes, with a series parallel arrangement of coils, enabling a wide range of standard voltages to be obtained. Direct-current supply for each section is obtained primarily from the shop three-wire system, supplemented by boosters, giving a very flexible arrangement, which permits machines of different voltages to be tested simultaneously. Eight stands are provided for testing small machines; most of these stands are designed to take either alternating or direct-current motors, and each one is complete with a load machine, instruments, switchboards, and load resistances.

The heavy machine test bed comprises a large pit, at the side of which is a heavy floor plate, giving facilities for erecting. In addition to the direct-current supply, a separate circuit is brought to this test bed direct from the power-house. A 400-kilowatt synchronous motor generator is installed behind the main switchboard; it consists of a self-synchronising synchronous motor driving two direct-current generators. The two generators can be controlled and used independently of each other, or can be connected in series or in parallel as required; in addition, they can be run as motors from the shop direct-current mains to enable the synchronous machine to be used as an alternator. The synchronous machine is specially wound to give single-phase, two-phase or three-phase supply at various voltages and at any frequency from 25 to 60 cycles. The equipment of this heavy machine test bed includes four variable-speed 500 brake horse-power machines which can operate either as motors or generators and can be run singly or coupled together and connected either in series or parallel for driving or being driven by machines on test. The arrangements for testing medium-size machines are generally the same as for the heavy machines, but on a smaller scale. In addition to the supplies already mentioned, the direct-current supply can be amplified by means of two boosters driven by a 130 brake horse-power induction motor, and the alternating-current supply can be amplified by a 100 kilovolt-ampère motor-driven alternator which is reversible and can be utilised as a load machine. The preliminary testing of armatures, field coils and stator and rotor windings is carried out in different parts of the manufacturing bays.

FIG. 6—PUMP BAY AT MATHER AND PLATT'S WORKS

one of which is arranged for testing small motors and generators up to about 50 brake horse-power, another for large machines up to about 200 brake horse-power, and the third for dealing with the heaviest machines. One of the chief difficulties encountered in designing an equipment of this kind is in providing and controlling the variety of electric current supplies, direct and alternating, of all powers, voltages and frequencies. The whole of the plant for this purpose is placed against the end wall, thus conveniently utilising space which is outside the useful crane area. The control switchboards extend in a straight line across the three bays. Behind them all the transformers and motor generators required for the test bed supplies are placed.

Some views in the works are given herewith and on page 625.

METROPOLITAN VICKERS ELECTRICAL COMPANY.

One of the most interesting works that were visited was that of the Metropolitan Vickers Electrical Company at Trafford Park, Manchester. The works occupy about 130 acres, and the effective floor space in the shops amounts to about 1,500,000 square feet. Normally about 9000 workpeople are employed. Hitherto the power for driving the works, which amounts to about 4000 kilowatts, was generated in the works, but a sub-station has recently been built to replace the original generating plant, and the

THE WORKS AT NEWTON HEATH OF MATHER AND PLATT, LTD.

(For description see page 623)

FIG. 7—VIEW IN THE ELECTRICAL TESTING DEPARTMENT

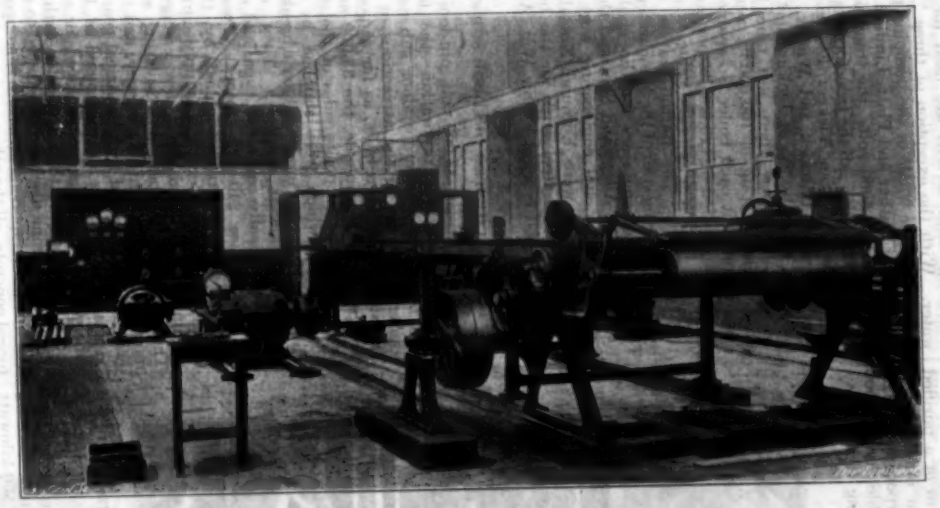


FIG. 8—ELECTRICAL TESTING STAND

FIG. 9—HEAVY MACHINE BAY

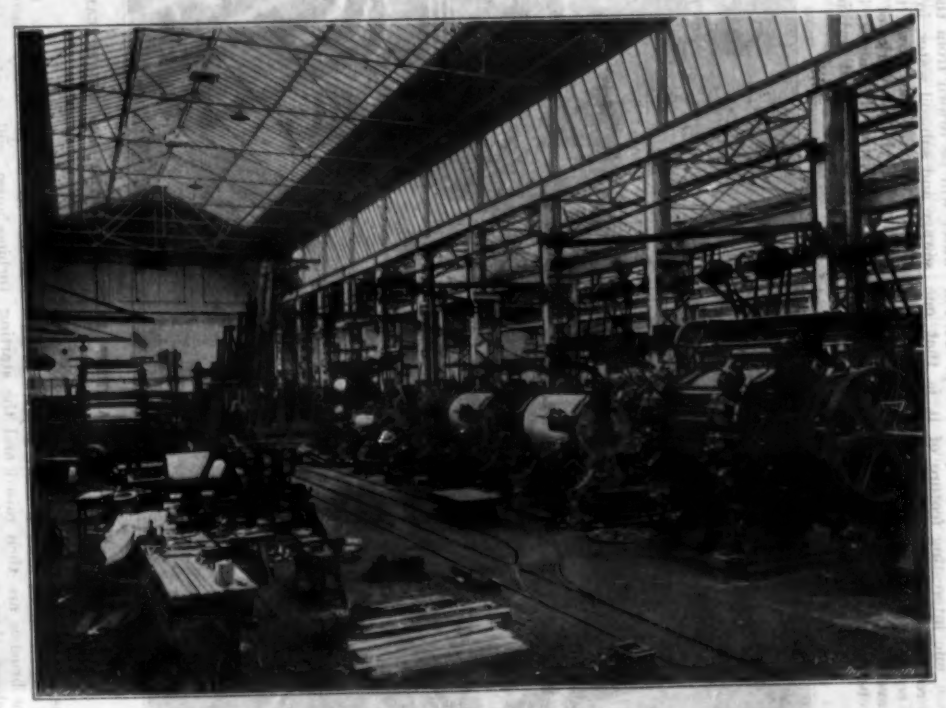


FIG. 10—TEXTILE MACHINERY BAY

current is taken from the Corporation's mains. This sub-station, which is laid out on very elaborate lines, and which has a capacity of about 5000 kilowatts, is noteworthy in several respects, see p. 634. For instance, one interesting feature of it is that one of the rotary converters is started automatically.

The equipment is arranged for automatic starting in the event of the voltage on the sub-station bus-bars falling below a given value, or for hand operation by means of a push button. When starting up the main oil switch closes after a short adjustable time lag. The brushes are then raised and the starting contact closes, thus causing the machine to rotate. If the machine builds up its voltage in the wrong position, a polarised relay operates a field-reversing switch and so corrects the polarity. When the correct polarity has been obtained, the starting position contactor opens and the running contactor closes. The brushes are then lowered, and when the field has built up the equaliser and neutral contactors close. The first direct-current line contactor then closes to connect the rotary converter to the bus-bars through a limiting grid resistance, and if the current drawn from the direct-current side of the machine is not excessive the second direct-current line contactor closes and short circuits the limiting resistance. When the load falls to a given value a time-delay device, which can be adjusted to operate in from two to twenty minutes, shuts the machine down. The control bus-bars are then de-energised and all the direct current and alternating current contactors, and the main oil switch open, thus putting the equipment entirely out of service. The time taken for starting is from fifty to sixty seconds, whilst that needed to close down is under five seconds after the operation of the time-delay relay. The automatic rotary converter, which is mentioned above, has a capacity of 1000 kilowatts. It is fitted with roller bearings, and runs at a speed of 750 revolutions per minute. It is a six-phase machine, and delivers direct current to a three-wire system with 500–525 volts between the outers. The machine is designed for tap starting, and is fitted with an over-speed protective device. The main transformer is of the oil-immersed self-cooled type. Three-phase 50-cycle 6600-volt current is transformed to six-phase 370-volt current, which is converted into direct current by the rotary converter. A tapping is taken from the mid-point of the transformer, and is connected to the neutral wire of the three-wire system. A considerable amount of alternating current, for use for various purposes, is also supplied to the works from this sub-station through static transformers.

No attempt can be made here to describe all the departments of this company's large works, or even to refer to the many interesting machines and apparatus which were brought to the notice of the visitors. Some large orders for turbo-alternators were in hand, including a 25,000-kilowatt set for the Manchester Corporation, and an 18,000-kilowatt set for the Metropolitan Railway. There was also a very fine display of switchgear, traction motors, &c. The research laboratories and the wireless broadcasting station was also inspected, and altogether the visitors spent a very instructive afternoon in viewing these works.

THE BARTON STATION.

The new Barton station of the Manchester Corporation, to which we briefly alluded last week, and which was visited on June 6th, is situated in Trafford Park on the southerly side of the Bridgwater Canal. Within the limits allowable, the condensing water will be drawn from the Ship Canal with the sewage and sub-soil water, in the form of a purified effluent which passes down the main outfall sewer to the Davyhulme works of the Corporation. The site, comprising, 14½ acres, is suitable for 150,000 kilowatts of plant, but certain limiting factors may possibly preclude developing the station to that extent. As we previously stated, the new existing turbine-house will contain three 27,500-kilowatt turbo-alternators with a maximum output of 31,250 kilowatts for short periods. The machines have been built by the Metropolitan Vickers Electrical Company, and the condensers by Richardsons, Westgarth and Co., Limited. Power for the station auxiliaries is supplied in part by three 1000-kilowatt 400-volt house-service turbo-alternators, built by the British Thomson-Houston Company, which also supplied the main and auxiliary switchgear. The steam pressure of the main units is 350 lb., the steam temperature 700 deg. Fah., the speed 1500 revolutions per minute, and the vacuum 29.1in., at full load, with the barometer at 30in. Six electrically driven circulating pumps are provided, there being two pumps for each condenser, and the circulating water is drawn from and returned to the Manchester Ship Canal through culverts 9ft. 6in. in diameter. The inlet chamber is composed of concrete, the bottom being 26ft. 6in. below the water level of the Ship Canal, and about 50ft. below ground level. Brackett travelling hand screens are used for straining the water. With the exception of three "Weir" boiler feed pumps the whole of the pumping plant has been supplied by Mather and Platt, Limited. The current is generated at 6600 volts, the transmission pressure being 66,000 volts. All the transformers were supplied by the Metropolitan Vickers Electrical Company, the boilers by Babcock and Wilcox, and the coal unloading plant by W. J. Jenkins and Co., Limited. In the boiler-house there are nine boilers. The most efficient rating is 100,000 lb. per hour actual evaporation, but each boiler is capable of maintaining an evaporation of 120,000 lb. per hour when fired with coal having a calorific value of not less than 10,500 B.Th.U. The Barton station was designed by the engineering staff of the Manchester Corporation. The consulting engineers for the civil engineering work were C. S. Allott and Son, and the contractors for the general civil engineering work, apart from the steel work, were Edmund Nuttall, Sons, and Co., Limited, the steel work for the building being constructed and erected by Sir Wm. Arrol and Co., Limited.

FIG. 11—COTTON COVERING DEPARTMENT—BRITISH INSULATED AND HELSBY CABLES, LTD.

THE MANCHESTER OUTDOOR SUB-STATION.

The High-street 33,000-volt outdoor sub-station of the Manchester Corporation—the first example of a large high-pressure outdoor sub-station in this country—was one of the attractions at Manchester. The station has been built, as far as possible, on the straight-through principle, the 33,000 and 6000-volt feeders being on opposite sides of the station. The oil switches, which were supplied by the British Thomson-Houston Comapny, have a breaking capacity of 500,000-kilowatt amperes. They are of the remote electrically controlled typo, and are operated by single-phase 240-volt motors. Two 50-ampère hour, 60-cell batteries, supplied by the Chloride Electrical Storage Company, supply current for the opening circuits and for a few emergency lights. The duplicate bus-bars and isolating switches are mounted above a central gangway, and the isolating switches are operated by mechanical gear. The bus-bars and conductors are composed of 1¼in. copper tube. Coned couplings are employed for all the joints and connections, so that a circular outline is maintained and corona discharge is reduced to a minimum. The bus-bar supporting structure is composed of reinforced concrete, all the other apparatus being mounted on concrete plinths at the ground level. The oil tank type switches have compound-filled bushings and explosion chamber contacts, the chambers consisting of an inverted steel cup which is lined with insulating material and fitted over the contacts, their function being to minimise the stress in the main tank sides and to assist in rapidly extinguishing the arc when the switch opens. The lightning arresters are of the oxide film type. The 6600-volt switchgear is of the concrete cubicle type, with two separate steel tanks per phase. By means of a special arrangement of auxiliary bus-bars any feeder can be kept in service whilst its switchgear remains dead for cleaning and other purposes. The transformers were supplied by the Metropolitan Vickers Electrical Company, and the voltage regulators by the Oerlikon Company.

FIG. 13—CABLE ARMOURING MACHINE—BRITISH INSULATED AND HELSBY CABLES, LTD.

THE WORKS OF THE BRITISH INSULATED AND HELSBY CABLES, LIMITED.

The works of British Insulated and Helsby Cables, Limited, which were established in 1891, and which were visited on Thursday, June 7th, are situated at Prescot, a few miles from Liverpool, and are admirably equipped for the manufacture of paper-insulated cables. The works stretch from Prescot railway station entrance northward in the shape of a fan, and adjoining the offices is an old export department, which is now used mainly for the unloading goods received, the department being equipped with three overhead travelling cranes, each having a lifting capacity of 15 tons. At the point where the old factory joins the new factory are the scrap copper melting furnaces, where the scrap copper is baled under hydraulic pressure, melted and run into billets with chamfered ends for easy introduction into the reduction rolls. In the rolling mill department the ingots or billets are re-heated in special muffles, introduced into the rolls from which the copper rod emanates on to the polished steel floor of the mill. As the rod proceeds from pass to pass of the reduction rolls it gains speed, and after its journey to and fro, it is finally passed into a power-operated winder and is quickly run into a coil, which is passed on to the cooling and pickling baths.

In the wire-drawing shop there are machines for drawing down the wire to innumerable sizes, from the largest size of trolley wire down to the finest instrument wire, which is only 1 mil in diameter. Adjacent to the wire mill are the Bates and Peard annealing furnaces, in which the wire is raised to the necessary temperature in a water-sealed retort, so that the heated metal never comes into contact with the air, with the result that there is no oxidation. The wire leaves the water clean and bright after passing through the furnace on an endless chain conveyor. In the stranding shops the wires are combined into stranded conductors and allowed to cool slowly on a drum at the end of each machine, whilst in the paper-insulating department the paper is lapped by means of machines layer by layer upon the stranded conductor. There is also an oven passage in which the paper-insulated cables are dried in special vacuum ovens or otherwise according to specification. The lead-covering department contains vacuum impregnating chambers, compound tanks and lead presses. The compound used has great dielectric strength, and has sufficient fluidity at all ordinary temperatures to render the cable flexible. The large lead-covering presses are hydraulically operated, and they form a lead sheathing on the cable as it passes slowly through the press.

The armouring department—see Fig. 12—is an excellently designed and constructed steel frame shop 500ft. long, and is served by a high-speed overhead travelling crane of 15 tons capacity. The floor is laid with granite paving blocks, having heavy-section grooved railway tracks sunk flush, so that the finished product can either be loaded direct into railway trucks or on to motor wagons. In the test and tank house there are three large water tanks for the reception of the cables. The lead-covered cables receive their coating of bitumen, layer of hessian tape, steel wire or steel strip armour, more bitumen, a further layer of tape, and lastly a coat of whitewash as the cable is wound on the final drums.

The cotton covering department is shown in Fig. 11. The telephone cable making department is just as interesting as the power cable departments. Here the process of stranding, paper insulating and the laying up of the pairs are carried out, the number of pairs varying from 1 to 1000 or more. There are also tinning shops, where the copper wire passes through the tinning bath, and an enamelled wire department, which is equipped with the latest machines for carrying out the enamelling process. Adjacent to this department are the iron and brass foundries, which are designed for dealing with a large amount of cast iron, malleable iron and non-ferrous castings, and close to these foundries is a large patternmaking and pattern-storing department. In a large fitting department various electrical accessories are made, such as reactances, electric welders, tramway and electric railway overhead gear and fittings, cable boxes, pillars, meters, cooling fans and various other kinds of smaller fittings. The so-called mechanical department is devoted to the design and construction and repair of most of the machines used in the factory, and also the firm's well-known paper pinions. Another department of equal interest is the aluminium section, which is equipped with sheet and rod rolling mills, wire drawing and extruding plant, all specially designed for dealing with aluminium. Other sections of the works are the joinery and building department, the power station and the works' canteen. There are also sports and recreation fields.

OTHER VISITS.

For the Liverpool trip on June 7th an extensive programme was arranged, including, in addition to the visit to the British Insulated and Helsby Cable works, visits to the Liverpool Corporation's tramways Lambert-road works; the automatic sub-station at Walton; the Lester-drive power station; the Cunard Company's liner ss. Scythia; the works of Lever Brothers at Port Sunlight; the works of the Automatic Telephone Manufacturing Company, Limited; the University Applied Electrical Laboratories; the Mersey Power Company's works; the United Alkali Company's power station at Widnes; and the London, Midland and Scottish Railway, Southport, electrified line and power station. At midday the members became the guests of the Tramways and Electric Power and Lighting Committee at luncheon at the Adelphi Hotel. Early on Friday morning the party left Liverpool for Llandudno, where motor coaches were waiting to convey the visitors by three alternative routes:—(*a*) *Vid* the Conway Valley, Bettws-y-coed, Capel Curig, Llanberis, Carnarvon, Bangor, returning by the coast road back to Llandudno. A halt was made on the outward journey at Dolgarrog, to inspect the hydro-electric power station, and the works of the Aluminium Corporation, Limited. Luncheon was provided at Dolgarrog by the Aluminium Corporation, Limited. (*b*) *Vid* Llanwrst and the Conway Valley, Bettws-y-coed, Capel Curig, Llanberis, Carnarvon and Bangor, returning by the coast road to Llandudno. At the Pen-y-Gwryd Hotel, the coaches proceeded towards Beddgelert and a halt was made at the Bluff immediately overlooking the Cwm Dyli power station, where the members disembarked and walked down the hillside to inspect the North Wales Power Company's hydro-electric power station. Luncheon was provided at the Royal Hotel, Capel Curig, and at the Pen-y-Gwyrd Hotel. (*c*) Over Conway Suspension Bridge and along the coast road to Penrhyn Castle, thence turning inland to Bethesda, where a halt was made to inspect Lord Penrhyn's slate quarries. The party then proceeded by the Nant Ffrancon Pass, returning *vid* Capel Curig, Bettwys-y-coed, Llanwrst and the Conway Valley to Llandudno. In the evening there was a reception and dance at the Grand Hotel, Llandudno.

The hydro-electric works of the Aluminium Corporation, Limited, at Dolgarrog, which we had the pleasure of visiting, are situated in the Conway Valley, on the Carnarvonshire side of the river Conway, about 7 miles from Conway. The works, which were started in 1907, produce aluminium in various forms, such as ingot, notch bar, sheet discs, powder foil, &c. Besides a hydro-power station with a capacity of 5500 kilowatts, the works comprise a carbon factory for producing the electrodes for the furnaces, reduction works, a recast department equipped with resistance furnaces, a rolling mill, powder factory, and foil works. There are also a fitters' shop, smithy, joiners' shop, stores dispatch department, &c. The hydro-electric development scheme at Dolgarrog is on the north-eastern slopes of Carnedd Llewelyn, and includes the lakes Eigiau, Cowlyd and Dulyn, situated at altitudes varying from 1000ft. to 3480ft. In 1907 a dam was built at Eigiau capable of impounding 160 million cubic feet of water. Later a tunnel was driven from Eigiau to the Dulyn River in order to obtain the waters of the Dulyn area and bring them into the Eigiau storage. The surplus waters of Llyn Cowlyd were also made use of, so that a total drainage area of over 10 square miles is controlled, and by means of an open leet brought to the forebay and penstock above Dolgarrog works, where a head of 1030ft. is obtained. The rainfall in the area varies between 70in. and 100in. per annum.

The power plant originally installed consisted of four 1600 horse-power Pelton wheels of Ganz design, coupled to Bruce Peebles direct-current generators directly connected to a series of induction furnaces. Besides the existing generating plant there are also two motor generator sets each having an output of 600 kilowatts on the direct-current side. On the alternating-current side the 1000 horse-power induction motors are supplied with current at 1050 volts, the supply being derived from the North Wales Power Company by means of a 20,000-volt transmission line. In 1918 the Aluminium Corporation acquired a controlling interest in the North Wales Power Company, and by the amalgamation of the only high-pressure hydro-electric stations in England or Wales, the Corporation acquired the means of developing the hydro-electric resources in North Wales to the public advantage, as set forth in the scheme submitted to the Electricity Commissioners for the supply in the North Wales and Chester Electricity District. In order to supplement the supply of power to the North Wales Power Company, two 1200-kilowatt three-phase alternators coupled to Pelton wheels have been installed in lieu of direct-current generators, which have temporarily been removed. At the present time the generating plant installed at Dolgarrog consists of three 1000-kilowatt direct-current sets, two 1200-kilowatt alternators, one 150-kilowatt works alternator, and one 30-kilowatt direct-current lighting set, giving a total generating capacity of 5580 kilowatts. Under the scheme for supplying current in the North Wales area, in conjunction with the North Wales Power Company, a new 30,000-kilowatt station is being built at Dolgarrog. Three 5000-kilowatt sets are to be installed in the first instance, and a new pipe-line, 4ft. 6in. in diameter, is to be laid. The sets will generate current at 6600 volts, which will be transformed up to 35,000 volts for transmission along the coast, and to supplement the existing supply of the North Wales Power Company. It has also been proposed to step up to 110,000 volts in an outdoor sub-station forming part of a 110,000 volt ring system connecting Dolgarrog power station with the proposed Maentwog station, and to transmit power in bulk to the eastern area of the North Wales and Chester district.

FERGUSON, PAILIN'S WORKS.

Taking advantage of the fact that a number of electrical engineers were coming to Manchester to take part in the Institution's summer meeting, Ferguson, Pailin, Limited, of Higher Openshaw, Manchester, invited members and others to inspect their switchgear works. This visit, it should be understood, was not part of the Institution's outing, but a purely privately arranged affair which preceded the official gathering on the Tuesday morning following. Quite a number of engineers availed themselves of the invitation and spent an interesting afternoon in inspecting the firm's shops and various forms of switchgear in the course of construction and completed. Into the history of this firm we cannot, unfortunately, find space to enter. It must suffice for us to say that at the present time it is making central station switchgear of the cellular type with breaking capacities up to a million kilovolt ampères, sub-station switchgear of various types, factory and mining switchgear, transmission line apparatus, outdoor sub-station gear, &c. In 1919 the many alterations and additions which had been made from time to time to enable the firm to cope with its increasing business were found quite inadequate, and late in that year ground was purchased within a hundred yards of the original works, which are still retained. In 1922 new works, covering a floor area of 1600 sq. yds., were completed. Throughout these works the machinery is of the most modern design and is for manufacturing specialised units on the mass production principle. The new works comprise a capstan and turret lathe section, an industrial and mining type switchgear assembly department, a power press and machine shop, an experimental department, drawing-offices, raw material stores, an instrument transformer department, a small capstan lathe and drilling machine section, casting stores, a printing plant and photostat department, a milling machine shop, a grinding and polishing shop, a patternmaking department, a truck-type switchgear shop, a switchboard erecting shop for large oil-immersed compound-filled switchgear, a receiving department, a switchboard frame

FIG. 13—EXPERIMENTAL SHOP OF FERGUSON, PAILIN, LIMITED

erection section, equipped with a special chopping machine for cutting angle and flat iron, a development department, a boiler-plate shop, equipped with a 100-ton blanking press, a stove enamelling department, a plating department, assembly galleries, sub-station, test-room, offices, and a roof garden. A view of a portion of the truck-type switchgear department is shown in Fig. 15, which gives some idea

FIG 14—FERGUSON, PAILIN, LTD.—TESTING DEPARTMENT

FIG. 15—FERGUSON, PAILIN, LTD.—TRUCK-TYPE SWITCHGEAR DEPARTMENT

of the class of work the firm is undertaking, whilst Fig. 13 shows a portion of the experimental department. Fig. 14 shows a corner of the test-room.

Upon these works a great deal might be written, but we must pass on to a device which the firm has introduced for tripping switches. This new type of operating gear is constructed to form a compact

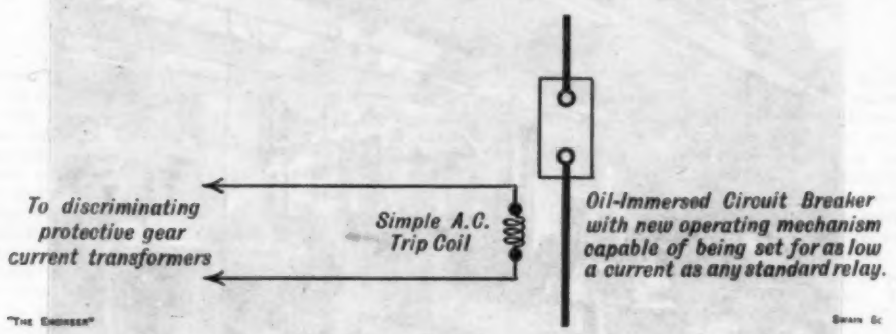
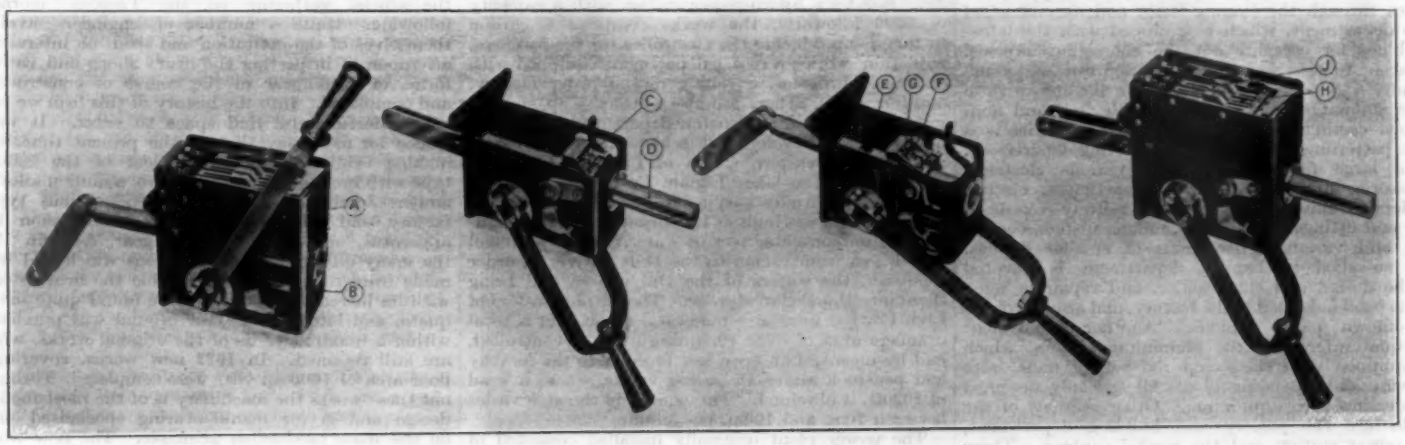

To discriminating protective gear current transformers
Simple A.C. Trip Coil
Oil-Immersed Circuit Breaker with new operating mechanism capable of being set for as low a current as any standard relay.

FIG. 16—DIAGRAM OF DIRECT-TRIPPING CIRCUIT BREAKER

self-contained unit suitable for mounting on switchboard panels of any desired thickness. The basic principle of the device is that when the operating handle is raised to the "engage" position, ample mechanical energy is stored in a spring to release the circuit-breaker when the gear is tripped by hand or electrically. As a result, electrical relays, auxiliary tripping batteries or separate current supplies, fuses, and auxiliary switches, are eliminated, the complete electrical arrangement being illustrated in Fig. 16, in which a single-phase scheme is shown to simplify explanation. The operating gear can be used in conjunction with all forms of protective gear, including the split conductor, earth leakage and balanced discriminative systems. For reverse power protection, a relay is used, which, when operating, opens the circuit and causes the fault current to circulate through the electrical tripping device, and a no-volt device can be supplied when required. Because of the small amount of current required to release the mechanism, it is possible to use ring-type current transformers for small current circuits, and when it is necessary to provide wound transformers for operating wattmeters, it is possible to operate the meters in series with the trip coils without any appreciable inaccuracy being introduced, so that only one set of transformers is needed.

The whole of the mechanism is enclosed in a pressed steel dustproof case, as shown in Fig. 17, and can be supplied with grease or oil, so that all the parts are well lubricated and are independent of atmospheric conditions. The case is in two parts—see Fig. 17—the upper part A containing the trip coils, and the energy-storing mechanism, and the lower part B the toggle mechanism and clutch device. The mechanical arrangement which releases the switch—see Fig. 18—consists of a toggle mechanism actuating through a steel ball clutch C on to a steel bolt D, which is directly connected to the circuit breaker lever. The hardened steel bolt has an annular groove E—Fig. 19—which receives the ball clutch. The engaging ball F is ¼in. in diameter, and is capable of efficiently resisting the shearing stress when the circuit breaker is closed. The ball F is held in the groove E by a hardened steel roller G, which is carried on a lever as shown. When the operating handle is moved to the top or engage position, as shown in Fig. 17, a re-setting roller attached to the ball carriage engages with a re-setting arm and stores energy in a spring. When the switch is tripped, there is ample energy to release a tripping hammer which strikes a tripping arm, the latter throwing over the roller bridge into the position shown in Fig. 19, thus releasing the ball from the annular groove and leaving the main bolt quite free. The weight of the moving contacts, together with the action of the powerful spring, then separates the contacts at a very high speed. Into the end of the bolt D an adjustable steel eye bolt is screwed for coupling to the circuit breaker lever by means of links, thus allowing for accurate adjustment between the operating gear and the breaker. The operating gear is connected to the circuit breaker lever through an adjustable coupling, so that to set the apparatus it is merely necessary to place the breaker and the lever in the full-on position, and to adjust the coupling until it is taut. The electrical tripping device consists of three or more U-shaped electro-magnets with armatures, and to these calibration arms H—Fig. 20—are attached, and these arms are fitted with balance weights J. The various settings are obtained by altering the positions of the balance weight, the whole of the settings being obtained without variation of the air gap. The attraction of any of the armatures causes the calibration arm to strike a metal shutter attached to a freely rotating spindle, which is the restraining member.



FIGS. 17-20—FERGUSON, PAILIN, LTD.—SWITCH MECHANISM

A VACANCY in the Inter-State Commerce Commission has been filled by the appointment of Mr. Frank McManamy, who was at one time an assistant in and, later, the chief of, the Bureau of Locomotive Inspection under the Commission and during the Federal control of the United States railways was Assistant Director of Operations. Were such an appointment made in this country the man would be above suspicion, but this does not seem to be the case in America. The *Railway Age* of May 19th, commenting editorially, says: "We fear he will be expected by organised labour to favour a policy of regulation adverse to private management, and it will be apprehended by railway officers that he will do so." We are glad to see that our contemporary does not think that this will be so, and it quotes the case of Mr. E. E. Clark, who was a labour leader, yet, being made a member of the Commission, rose to be its chairman, and was "one of the ablest, fairest and most constructive members of that body."

A Seven-Day Journal.

A New Type of Flying Machine.

A SHORT time ago particulars were published in this country of a new type of flying machine invented by a young Spanish engineer, Juan de la Cierva. Additional information just received makes the action of the machine clearer than was previously the case, although even now it is somewhat hard to be sure that we have got it correctly. The machine is neither an aeroplane, a helicopter, nor an ornithopter, but something between all three. It consists of an aeroplane body with elevators, tail fin, rudder and ailerons, but without wings, together with an ordinary two-bladed tractor screw. From about the centre of gravity of the machine a shaft extends upwards for a few feet, and at its end is provided with a large four-bladed screw, the blades of which extend in a plane making a small angle of incidence to the horizontal. No power is supplied to rotate this large screw, but when the machine is propelled forwards by the tractor screw the large screw turns windmill-like in the relative wind and develops lift. It appears that the blades of the large screw are hinged to the shaft, so that each may independently assume a stable position under the joint action of the lift developed by it and centrifugal force. Moreover, the shaft, as a whole, is apparently pivoted so that it may automatically take up the position prescribed for it by the resultant forces and moments acting upon it. The object of these arrangements is, we gather, to neutralise the tendency of the machine to bank under the inequality of the lifts developed by the separate blades of the large lifting screw. The machine is known as the "Autogira," a name which seems to indicate that the main object of its designer was to secure stability. During tests at Madrid it is said to have shown its ability to descend, with the engine cut off, almost vertically, the horizontal landing speed not exceeding 6 miles an hour.

Salving the Egypt's Treasure.

LAST March it was reported that an attempt was to be made to salve the consignment of gold and silver, valued at £1,100,000, which was lost when the P. and O. liner Egypt sank after collision off Ushant on May 20th, 1922. We expressed some doubt at the time as to whether the depth at which the wreck was lying, estimated at over 60 fathoms, would not prove a prohibitive obstacle to the success of the operations. The enterprise is, however, we understand, being proceeded with, and after a month's tedious work, the salvors, it is reported, have succeeded in locating the wreck or what is believed to be it. The rights to salve the bullion have been acquired by Mr. C. P. Sandberg, consulting engineer, and Mr. J. Swinburne, with whom are associated in the operations the Gothenburg Towage and Salvage Company. The company's vessel Fritiof and two steam trawlers, the whole under the command of Captain K. Malmborg, the company's director, are now engaged on the work. Preparation of the salving appliances required is being begun, but it is anticipated that some time will elapse before everything is ready for an actual start on the operation of recovering the bullion.

Surplus Government Property.

OUR note in last week's Journal regarding the property remaining in the hands of the Disposal and Liquidation Commission may now be supplemented by the statement that the two firms referred to with which negotiations have been in progress for the sale of the material on a commission basis are Sir W. G. Armstrong, Whitworth and Co., Limited, and George Cohen, Sons and Company. The material, &c., which these firms will take over and sell on behalf of the Commission, will include locomotives and rolling stock, railway material and equipment, iron and steel buildings, huts, metals, electrical plant, aerodromes, furniture, medical stores, &c. It is expected that the material covered by the arrangement will realise on sale about six million pounds. Messrs. Cohen are just on the point of completing a previous contract with the Disposal Commission for the breaking down of 400,000 tons of high explosive and other shells. This contract has given employment to 7500 workers, has resulted in sales amounting in value to over three million pounds, and has occupied in its fulfilment considerably over a year. It has yielded steel, brass and copper for re-manufacture, and over 10,000 tons of ammonium nitrate for fertilising purposes.

Another Oil Port on the Thames.

IT is reported that yet another scheme for the establishment of a large new oil port on the Thames is under consideration. A lease of 300 acres of land with an extensive river frontage has, it is understood, been acquired by a syndicate in which the Scottish-American Oil and Transport Company is interested. The site is near Gravesend, on the opposite bank of the river to Thames Haven, the oil port of the London and Thames Haven Oil Wharves Company. At Purfleet is the depôt of the Anglo-American Oil Company, and at Shell Haven is the refinery owned by the Shell Company. In the early part of this year Cory Brothers, of Cardiff, acquired a site near Canvey Island for the establishment of an oil depôt. Before the war great fear was expressed that in times of hostilities our oil reservoirs would form very vulnerable points of attack by hostile aircraft, and the Admiralty was credited with the intention of constructing underground tanks in the neighbourhood of Portsmouth, with the view to avoiding this contingency. The thought must, therefore, arise whether it is desirable that the lower banks of the Thames should be encumbered with a growing number of immense private oil depôts, for the situation is such as to make the tanks easy and readily found targets by aircraft coming from the Continent. In this connection it is reassuring to learn from Mr. Burgess, the managing director of the Thames Haven Oil Wharves, that the dangers of petroleum storage in war time have been found by actual experience to have been exaggerated. Giving evidence on Tuesday before the Select Committee of the House of Lords, which is now considering the Petroleum Bill, he stated that his company's stores were constantly attacked during the late war, but that no damage had been done except on one occasion when a bomb penetrated an oil tank, and even then, so he reported, the fuse was extinguished by the oil.

A Large Naval Floating Dry Dock.

DURING the week reference was made in the daily Press to the naval dry dock surrendered by Germany under the terms of the Peace Treaty, which is now being prepared for special naval service at Chatham Dockyard. The dock referred to is one of two docks handed over, which were formerly used by the German Naval authorities at Kiel and Wilhelmshaven. It is a six-section dock of 40,000 tons lifting power, having an overall length of about 700ft., and a clear entrance width of 148ft. Some of the machinery was damaged before surrender. The work of completing some new sections which are to be added and of putting the dock in working order is now proceeding. When completed, the dock will be capable of receiving the largest battleship afloat at present as well as the two new battleships, the Nelson and Rodney, which are now under construction on the Tyne and Mersey. It has been stated on trustworthy authority that the new dock will form part of the equipment at the new base at Singapore. If the floating dry dock for Southampton, which was described in THE ENGINEER of October 22nd last, is taken into consideration, this ex-German naval dock must be given second place as regards size and lifting power, since the Southampton dock will have a length of 960ft. and a lifting power of 60,000 tons.

Sir George Beilby.

THE Lord President of the Council has accepted, with much regret, the resignation of Sir George Beilby, after nearly seven years' voluntary service as Director of Fuel Research and Chairman of the Fuel Research Board under the Department of Scientific and Industrial Research. The Board was established in 1917 to investigate the nature, preparation and utilisation of fuel of all kinds. The Lord President has appointed Mr. C. H. Lander to be Director of Fuel Research, and Sir Richard Threlfall, a present member of the Board, to be Chairman. Sir Charles Parsons will continue his membership of the Board for a further period. Sir George Beilby retains his membership of the Advisory Council of the Department, and has consented to act as Honorary Adviser to the Board. The following gentlemen have accepted appointment as additional members of the Board:—Mr. R. A. Burrows, Sir John Cadman, Dr. Charles Carpenter, Mr. Samuel Tagg, Professor Sir James Walker, and Professor R. V. Wheeler.

Searching for Oil in Great Britain.

INTEREST in the discovery of profitable native sources of mineral oil is apparently far from being dead. A short time ago we learnt that the Mines Department of the Board of Trade had granted a licence to the Duke of Devonshire—the Colonial Secretary—"to search and bore for and get petroleum within and under the lands near Hardstoft in the county of Derbyshire." from which we may infer that the prospecting work begun on behalf of the Government by Messrs. Pearson in the last year of the war is to be resumed. A paper on the subject, we notice, was read on Tuesday by Mr. H. P. W. Giffard, of the Board of Trade, before the summer meeting of the Institution of Mining Engineers in Glasgow. Between them the recent operations in Derbyshire, Staffordshire and Scotland involved the sinking of eleven wells, five of which were carried to a depth of over 4000ft., and three to a depth exceeding 3000ft. The average cost worked out at £12.55 per foot. The well at Hardstoft, according to Mr. Giffard, produced 1000 tons of oil and is still flowing. For a considerable time it maintained a natural flow of seven barrels per day, or fourteen barrels by pumping, a production which, the author said, compared favourably with that of many wells in the United States. The oil was, he added, of remarkably high quality. Although in North Staffordshire the bore hole was not carried to a sufficient depth to give a conclusive test, the Derbyshire and Scottish borings, Mr. Giffard holds, yielded results which are very encouraging and which indicate that there is plenty of scope for exploratory drilling in these neighbourhoods.

The Nechells Power Station.

THE Birmingham Corporation's Nechells power station, which will ultimately have a capacity of 105,000 kilowatts, was formally opened by the Prince of Wales on Tuesday. At present the station contains two 15,000 turbo alternators, which were built by the British Thomson-Houston Company. A notable feature of the plant is the somewhat high steam pressure, namely, 300 lb. per square inch. Like various other municipal stations which have been erected within recent times, the Nechells station is built on very elaborate lines, and everything possible has been done to secure high efficiency. It is worthy of note that the instantaneous short-circuit current of the alternators is only about six times the normal working current, which represents a marked improvement upon the performance of alternators which were built in the past. Another feature worthy of mention is that on each alternator shaft there is a 250-kilowatt 440 to 460-volt shunt-wound generator, in addition to the usual exciter, and these generators supply current for operating the auxiliaries. This arrangement is, of course, unusual, a more common scheme being, in these days, to supply the auxiliaries from separate house turbines. The shortage of water, owing to the geographical position of Birmingham, has been overcome by utilising the sewage effluent for cooling purposes. This procedure is, of course, not new, but has been practised elsewhere for a very considerable number of years.

Sixty Years Ago.

IN last week's issue the subject of one of our leading articles was "Railway Speeds," and in it the view was expressed that the public was now indifferent to high speeds, that it did not care whether it travelled at times in excess of 100 miles an hour, but, content to trust its safety to the railway company, was primarily concerned only with the total period of time occupied in a journey. Sixty years ago, by a curious coincidence, we published—in our issue of June 12th, 1863—a leading article under the title "High Railway Speeds." Inspired apparently by an accident on the Brighton line near Streatham, we sought to combat the popular idea that high speeds on railways necessarily increased the risks of accident. On the contrary, we argued, high railway speeds promoted safety in that they rendered indispensable a great excellence of material and construction. Were speeds of 60 miles an hour to be abandoned for 30 "not even an Act of Parliament could ensure that the present standard of excellence would be maintained." We urged that, far from it being necessary to reduce railway speeds, it was most desirable to seek to increase them very considerably. To that end we suggested, among other modifications, that railway wheels should be truly cylindrical and not coned, and that they should revolve independently of each other. Among the notes inserted in odd corners of the same issue we find several facts recorded of much historical interest. In one it was stated that "paper is being made from wood in the United States on a large scale," and that "the *Boston Courier* is now printed on paper made of wood fibre." The process employed cannot be identified from the brief statement that "a beam of timber is sliced up by steam and paper made from the stuff." In another note we find it recorded that a company had been formed for working the patents of Mr. Daniel Siebe for the artificial production of ice. The working of this invention, it was added, was likely to lead to the most important commercial results. Under "Law Intelligence" the beginning was recorded of a historic patent action, Betts *v.* Menzies, in connection with the production of Albion metal, a substance formed by the union of lead and tin under pressure without heat. The case had already been tried three times and been carried through a court of error to the House of Lords, and was again being opened in the Court of Queen's Bench.

The Gas Turbine in Theory and Practice.

No. VII.*

WHILST in theory the success of the internal combustion turbine depends on the extent of the surplus of the positive work obtained from the conversion of the kinetic energy of the products of combustion which is still available after the quantity of negative work of compression or exhaustion has been overcome in the C.P. cycle, or both these and the amount absorbed in discharge to atmosphere in the case of the C.V. cycle, in practice the design, as has already been shown, is drastically restricted by the working conditions—that is, by the temperature to which certain parts are exposed, and it is desirable to make quite clear the direction in which this difficulty is mainly encountered. It is in what follows that the metallurgist is principally concerned.

There would be no difficulty whatever in arranging for a very high brake thermal efficiency if only materials subject to high continuous temperatures—1000 deg. to 1200 deg. Fah.—would simultaneously resist high stresses; but unfortunately the influence of even moderate temperature is to reduce the ultimate, and particularly the elastic limit, or, rather, the limit of proportionality, as it is better termed, very considerably, so that even portions subject to moderate static stresses are seriously affected at little more than half this range. In the matter of materials of construction, therefore, the would-be designer of an I.C. turbine is faced with very formidable difficulties, *unless he can so arrange the main principle of his design in such a manner as to obviate or else to overcome them.* The question of expansion when hot and the consequent distortion of cylinders and diaphragms was at one time the cause of much trouble in steam turbine work. With the increase of knowledge due to experience, this has now become a secondary matter, nor is it likely to prove particularly serious in I.C. turbine design, if the latter be carefully considered. The practical problem which does call for particular forethought lies in what materials can be used for the construction of the essential parts. The question is obviously a vital one, and there is no need to insist on the all-important quality of reliability in service. What does require emphasis is the fact that the same degree of reliability and of durability as is now obtainable with other prime movers will be required from the I.C. turbine, but necessarily under very much more drastic conditions of operation.

Probably the highest steam temperature employed in large turbine work to-day is 750 deg. Fah. at the turbine stop valve. This is used at the Gennevilliers station, near Paris, where the boiler pressure is 355 lb. By the time the steam reaches the first row of turbine blades, the temperature is probably reduced to below 600 deg., and it is approximately correct to assume that the first wheel, with a peripheral speed of about 600ft. per second, is usually running in a medium of no more than 550 deg. to 600 deg. Fah. As will be seen from the curves, this is practically the critical range for all steels. This figure is about the same as that at the first row of reaction blading in the Parsons 10,000-kilowatt machines at Carville and Dunston, where the initial blade speed is 235ft. per second. These machines were designed for 650 deg. to 700 deg. Fah. at the stop valve. Very different, then, are the conditions for the gas turbine, with Holzwarth using 880 deg. Fah. on a wheel running at 565 ft., or in the little Rateau exhaust turbines running at 850ft. per second in a temperature of 1100 deg. to 1200 deg. Fah. There is very little alternative to the use of cast steel for the cylinder, unless a simple forged design be adopted. The strength of cast iron falls off rapidly beyond about 600 deg. Fah., and even a good sample quality as used for certain Diesel work and stiffened by the addition of small quantities of aluminium and iron silicates, which retains an almost constant tensile strength of 15 tons per square inch from 60 deg. to 600 deg. Fah., will be reduced to 12 tons at 900 deg. Fah. and to 7.5 at 1100 deg. Fah. Steels fall off even more rapidly in proportion between these temperatures. Bronzes, of course, are hopeless; it is a very good sample which has an ultimate tensile strength of 5 tons at 800 deg. Fah. Holzwarth used an electro-steel with a very low carbon content for his blades, the yield being 13 tons and the breaking strain 17 tons at 840 deg. Fah. For the 3 per cent. nickel steel generally used for disc wheels, the ultimate strength is about 40 tons and the elastic 29 tons at normal temperatures, and factors of safety of 4 to 5 on the former and 2.5 to 3 on the latter are usually aimed at in moderate size wheels, and rather more in those of greater diameter. The best practice probably lies in using a factor based on a mean between the ultimate and the elastic strengths of, say, 3.25 to 4. In some of the little Laval wheels with very high peripheral speeds, the stresses in the wheel body ran up to 12 tons, and at the safety groove below the blade rim to 16 tons per square inch, but these wheels were always running under exhaust conditions, seldom involving a temperature of more than 150 deg. Fah.

Owing to the fact that after a temperature of about 600 deg. Fah. is reached, the strength of forged steel begins to fall so very rapidly, the rotor design for an I.C. turbine is seriously affected. Though this is one of the crucial difficulties to be negotiated, it seems to be greatly underestimated. In most patent designs it is utterly disregarded, and even in more serious publications the assumption seems to be tacitly made that material will meet the demand and that designers are comparatively free to run wheels almost as fast as they like in any temperature that will suit them. No more serious error can be made; it is a far worse mistake than that of assuming, for instance, an ultra-optimistic efficiency for the compressor. Until comparatively very recently the studied production of steels capable of withstanding high temperatures—*i.e.*, temperatures above 600 deg. Fah. or so—was very restricted; but fortunately for the future evolution of the I.C. turbine, a very considerable amount of research work on alloy steels has been undertaken, and is still in progress in connection with aeroplane engine parts, valves, crank and cam shafts, &c., and for several other purposes, such as metal gas retorts, pyrometer casings, &c., all of which involve the production of material of hitherto exceptional qualities, and the results of tests of these alloy steels over a wide range of temperature—data as to which was previously very scarce—which are now available, undoubtedly show that the most serious of the mechanical problems has been very greatly reduced. Most certainly we have not yet got a commercial material which can be relied on to withstand a continuous speed of 1000ft. per second in a temperature of 1000 deg. Fah., involving in the most suitable form of disc wheel a stress of over 10 tons per square inch, for although the ultimate tensile strength of certain alloy steels at this temperature does lie between 30 and 40 tons per square inch, the limit of proportionality has then dropped from roughly 50 or more per cent. to 20 per cent. or so, and it is in the reduction of the elastic limit that danger lies. The design of concavo-convex profile wheels of constant strength throughout, which may entail a rapidly tapering outline, is not a simple matter, and the mathematical investigations by means of which the stress equations are obtained usually neglect the effect of axial and shear stress, which, if the ratio of centre thickness to rim thickness be great, may be considerable. Foreign experience of an epidemic of bursting discs of steam turbines a few years back has shown how disastrous the results may be. It behoves those embarking on a range of far more drastic working conditions to profit by what has gone before!

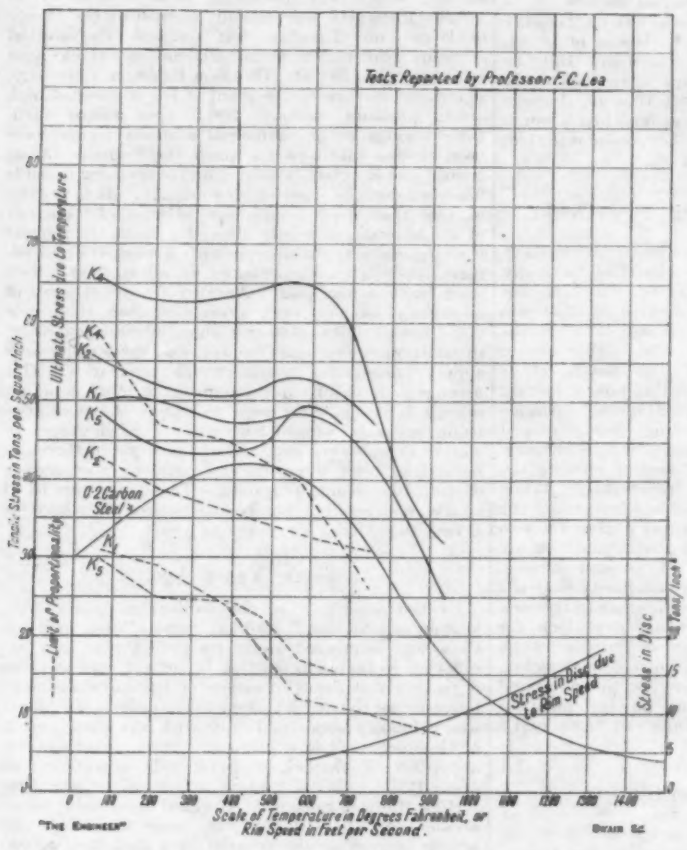

Tests Reported by Professor F. C. Lea
Tensile Stress in Tons per Square Inch
Ultimate Stress
Limit of Proportionality
K4
K3
K1
K5
K2
0·2 Carbon Steel
K5
Stress in Disc due to Rim Speed
Stress in Disc
Tons/inch²
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400
Scale of Temperature in Degrees Fahrenheit, or Rim Speed in Feet per Second.
"The Engineer"

FIG. 14

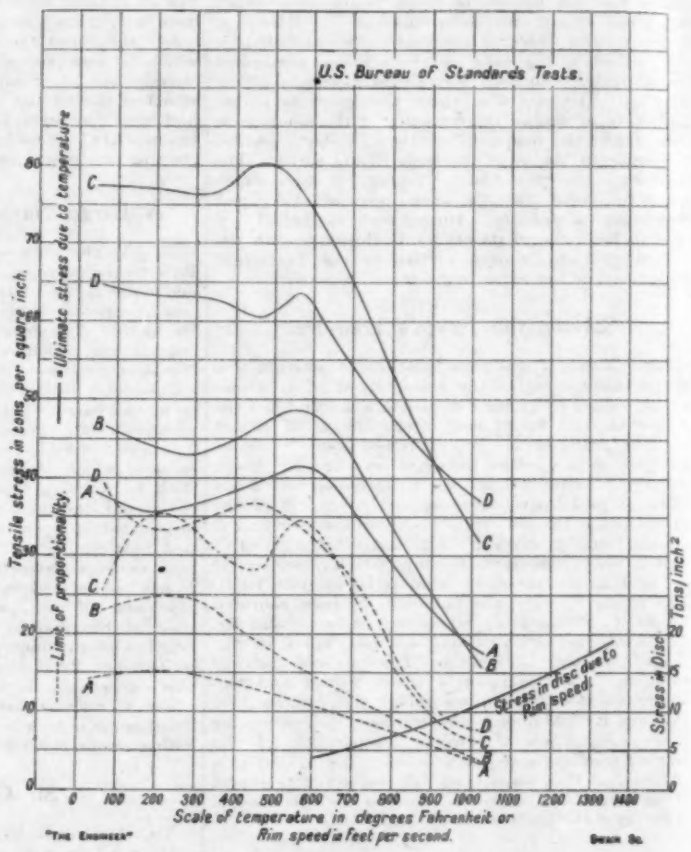

U.S. Bureau of Standards Tests.
Tensile stress in tons per square inch.
Ultimate stress due to temperature
Limit of proportionality
C
D
B
A
Stress in disc due to Rim speed
Stress in Disc
Tons/inch²
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400
Scale of temperature in degrees Fahrenheit or Rim speed in feet per second.
"The Engineer"

FIG. 15

Probably the would-be designer of an I.C. turbine is faced with very formidable difficulties, *unless he can so arrange the main principle of his design in such a manner as to obviate or else to overcome them.* The question of expansion when hot and the consequent distortion of cylinders and diaphragms was at one time the cause of much trouble in steam turbine work. With the increase of knowledge due to experience, this has now become a secondary matter, nor is it likely to prove particularly serious in I.C. turbine design, if the latter be carefully considered. The practical problem which does call for particular forethought lies in what materials can be used for the construction of the essential parts. The question is obviously a vital one, and there is no need to insist on the all-important quality of reliability in service. What does require emphasis is the fact that the same degree of reliability and of durability as is now obtainable with other prime movers will be required from the I.C. turbine, but necessarily under very much more drastic conditions of operation.

In Figs. 14 and 15 are given two series of curves showing the ultimate stress in tons per square inch and the limit of proportionality for two distinct sets of tests of special alloy steels. The former are compiled from the address by Professor F. C. Lea to the Junior Institution of Engineers delivered on February 9th last, and refer to "K" steels of the following composition:—

	C. %	Chr. %	Ni. %	Mn. %	
K_1	0.65	—	—	0.80	Hot rolled medium carbon steel
K_2	0.35	1.00	1.25	—	Hardened and tempered steel
K_4	0.35	0.60	3.25	—	High-tensile steel
K_5	0.35	0.60	3.25	—	High-tensile steel annealed

The latter refer to a series of samples tested last year by Mr. H. J. French for the United States Bureau of Standards, which were of the composition given in Table XIV. on the next page.

As it is proposed to deal with these latter tests in some future issue, it suffices now to remark that Mr. French's curves have been re-drawn to a tons/inch² in lieu of a lb./inch² ordinate, in order to render them directly comparable with those of Professor Lea, as compiled from Table III. of his address.† The base

* No. VI. appeared June 8th.

† See THE ENGINEER, February 16th, 1923, pp. 182-3.

of both diagrams serves as a Fahrenheit scale as well as a scale of peripheral wheel speed in feet per second for the wheel stress abscissæ. In choosing a disc profile such that the sum of the radial and tangential stresses results in a constant strength throughout the body of the disc, a concavo-convex outline is obtained, and if a ratio of thickness of 10 to 1, as between that of the centre and that of the rim, be accepted, then the total stresses incurred will be the same as those indicated in Fig. 6 (*ante*). This line is reproduced in each diagram in order to indicate how rapidly, at temperatures over 700 deg. Fah., the strength of the material falls and the stresses in the wheel rise. Professor Lea remarks that "our tests indicate that none of these materials would be of much use in gas turbines, where temperatures of, say, 750 deg. Cent. (1380 deg. Fah.) might obtain, or in metal gas retorts." The writer would interpolate that, in his opinion, this figure is nearly double the value which need be required for an I.C. turbine

TABLE XIV.—*Analysis of Steels from which the Curves given in Fig. 15 were Obtained.*

Steel.	C.	Mn.	P.	S.	Si.	Ni.	Cr.	V.	Heated for 30 minutes in designated temperature and cooled in still air.
A	0.38	0.56	0.014	0.013	0.14	—	—	—	1560 deg. Fah.
B	0.37	0.67	0.021	0.010	0.20	3.43	—	—	1470 deg. Fah.
C	0.39	0.59	0.019	0.009	0.23	3.05	0.93	—	1560 deg. Fah.
D	0.37	0.74	0.020	0.023	0.21	—	1.04	0.17	1560 deg. Fah.

capable of rendering a brake thermal efficiency of over 20 per cent. Professor Lea's table of "K" steel tests did not give ultimate stresses in temperatures exceeding 400 deg. Cent. (750 deg. Fah.), except for the K_1 and K_4 steels, for which records at 932 deg. Fah. were given, whereas Mr. French's tests were all carried out up to 550 deg. Cent. (1022 deg. Fah.), and while there is much of interest to be said about the curves in detail, this must be postponed. Attention, however, is required to the factors of safety involved in running at various speeds, 800ft. to 1000ft., in temperatures of 800 deg. to 1000 deg. Fah., and it is in this region that the curves of strength and stress require to be studied. In Table XV. are given the ultimate strengths and limits of proportionality at various temperatures, and also the factors of safety at various speeds using Mr. French's "C" and "D" steels as a basis. Obviously, with this wheel profile, temperature is a greater antagonist than peripheral speed, but with either material the stress exceeds the elastic limit at a speed and temperature of little over 900 each. What degree of durability these materials possess is very hard to say. The time-factor is a very important element, and further research in this direction is necessary. But it may be remarked that it is only during the last two or three years at most that extensive test results of these alloy steels at high temperatures have become available, and the progress which they represent over the materials at one's command in previous years is very encouraging. As it is intended to deal with the subject of alloy steels at high temperatures at a later date, fuller reference to the more detailed properties of these United States steels must be deferred. The tests owe their genesis to difficulties experienced with bolts in converter chamber heads in the attempted production of ammonia in the United States by the Haber process.

Most of the philosophy of internal combustion turbine design is to be found concealed in the range of the diagram which we have just been discussing and in Fig. 4—Part III., *ante*—in which the overall efficiencies of turbine and compressor are shown. The limits to wheel speed and exhaust temperature in the former, and the limit of attainable efficiency and compression ratio in the case of large volumes in the latter, are still, as they have always been, the fundamental factors in preventing the attainment of brake thermal efficiencies comparable with those of the heavy oil engine. Improvements in material and improvements in compressor efficiency, such as have been made during the last decade, are rapidly reducing the discrepancy between the past and the future. It may be remarked that such detail questions as nozzle and blade design have not been touched upon. To do so at this juncture would involve a lengthy discussion of a number of more important matters—such as choice of cycle, nature of fuel, intended brake efficiency, &c.—which require decision before the minor features of a design are tackled; but as far as can be seen, the nozzles themselves present no serious difficulties, and may be the subject of various satisfactory solutions as regards construction, though the exact proportioning for a given ratio of expansion may require some experiment, as was shown by the trials of the first Holzwarth turbine. The blades are a more delicate matter than the nozzles, but as the sum of the individual stresses therein are considerably less than those encountered in the rotor disc, an adequate factor of safety can be provided in spite of the fact that the impinging temperatures are high and that the gas velocities are very great compared with steam speeds. A more formidable difficulty than stress lies in the quality and degree of cleanliness of the impinging gas. Sulphur dioxide at high temperatures‡ or tiny fragments of solid foreign matter passing through the nozzles at high velocity are obviously both to be feared, and as far as possible avoided, for blade edges at 800 deg. to 900 deg. Fah. are not as robust as at 500 deg. Electro-steels with a very low carbon content and negligible quantities of phosphorus and sulphur offer a solution as regards the action of the gas. The latter action is common to every type of turbine—steam and water and gas—and must be restricted by means similar to those employed in the two former. A number of other questions, such as those concerned with starting up, governing or change of load, &c., must also be passed over for the more important questions of the principles involved.

CONCLUSION.

In the foregoing articles we have endeavoured to record the as yet fragmentary history and the present, if embryonic, status of the internal combustion turbine, as well as to indicate those fundamental difficulties which have defeated so many experimenters in the past, and which, in the future, will still form an impassable barrier to success except through certain clearly defined channels. The internal combustion cycle does not permit of that latitude in the extension of the working limits which the use of the turbine form of engine permitted in the case of steam for reasons of temperature and pressure at one end of the scale, and the entropy of gases at the other, and the inherently lower efficiency of energy conversion in the turbine mechanism as compared with the cylinder and piston cannot, therefore, be compensated by a corresponding extension of the cycle. With the introduction of steam turbine installations, the only real alteration in the method of utilising the heat in the fuel compared with the process by which this was effected in a piston engine plant, lay between the points of admission and release in the cylinders. Vast as was the subsequent mechanical result of this change, the broad principle of the external combustion cycle, with all the thermal losses due to the change of state of the working fluid, remained unaltered, but wherever cheap solid fuel is available this method—certainly for the bulk supply of power—will probably remain the cheapest as regards the fuel cost per brake horse-power developed.

TABLE XV.—*Factors of Safety in Disc Wheels Run at High Peripheral Speeds in High Temperatures.*

Wheel speed in feet per second and temperature Fah.	800ft. and 800° F.		900ft. and 900° F.		1000ft. and 1000° F.		1000ft. and 800° F.	
Stress in tons per square inch due to speed ..	6.8		8.45		10.4		10.4	
Stress in tons per square inch due to temperature and factor of safety	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.
C STEEL—								
Ultimate stress	53.5	7.87	42.7	5.05	33.5	3.22	53.5	5.15
Limit of proportionality	16.0	2.35	9.55	1.13	6.3	0.606	16.0	1.54
Ratio and mean factor of safety	29.9	5.11	22.4	3.09	18.8	[1.913]	29.9	3.345
D STEEL—								
Ultimate stress	47.7	7.02	45.4	5.024	37.9	3.65	47.7	4.58
Limit of proportionality	18.1	2.66	10.7	1.268	7.8	0.75	18.1	1.74
Ratio and mean factor of safety	38.0	4.84	25.25	3.146	20.6	[2.2]	38.0	3.16
Wheel speed in feet per second and temperature Fah.	800ft. and 900° F.		900ft. and 800° F.		1000ft. and 900° F.		900ft. and 1000° F.	
Stress in tons per square inch due to speed ..	6.8		8.45		10.4		8.45	
Stress in tons per square inch due to temperature and factor of safety	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.	Tons per sq. in.	Factor of safety.
C STEEL—								
Ultimate stress	42.7	6.28	53.5	6.335	42.7	4.1	33.5	3.964
Limit of proportionality	9.55	1.40	16.0	1.895	9.55	0.918	6.3	0.746
Ratio and mean factor of safety	22.4	3.84	29.9	4.115	22.4	[2.509]	18.8	[2.35]
D STEEL—								
Ultimate stress	42.4	6.24	47.7	5.65	42.4	4.08	37.9	4.486
Limit of proportionality	10.7	1.574	18.1	2.145	10.7	1.03	7.8	0.924
Ratio and mean factor of safety	25.25	3.907	38.0	3.9	25.25	2.805	20.6	[2.055]

As a power producer, conditions of convenience greatly favour the use of the internal combustion cycle in which the heat addition is due to changes occurring in the motion fluid itself, and engines working on this principle have registered brake thermal efficiencies of nearly double the best that have been obtained with the external combustion cycle, though the ratio of the heat utilisation compared with the theoretical amount possible in each case, is virtually the same as far as the engine only is concerned. So high, in fact, are these ratios—70 to 80 per cent.—that their extension within the existing cycle limits is by no means easy. But, however economical and convenient of application the existing I.C. may be in its better types, it possesses, like everything else, distinct limitations. For small units, such as motor cars or aeroplanes, it has no competitor, and none is in sight; for moderate size units, in which space is limited or in which the cost of coal and of liquid fuel are less widely separated than they are in some parts of the world, the I.C. is rapidly gaining ground. In no direction is this more remarkable than in marine propulsion, in which the oil engine is now a sound, if primarily a costly, alternative to the geared turbine and the once universal reciprocating steam engine. For powers up to 3000 or 4000 horse-power per shaft, and even more now that the double-acting design is being adopted, the extent to which the oil engine has been fitted in lieu of other forms of propelling machinery, is one of the most striking features of the quarterly shipbuilding returns of the last few years. For the bulk supply of power, however, the restriction to power per engine unit, as compared with steam, in association with its lack of flexibility, definitely restricts its adoption, and the latest returns for Great Britain (1921–22) show that only 0.67 per cent. of the electric power output of all stations falling under the control of the Electricity Commissioners is developed by oil engines, and only 0.316 per cent. in gas producer stations. For high-power marine work, where weight and height of installation are factors of importance, the reciprocating oil engine is virtually impossible to install, and the steam turbine, with a brake thermal efficiency of about 16 per cent., offers at present the only solution.

It may well be asked, then, what is the *rôle* that the internal combustion turbine can be expected to fulfil, and the question is none the easier to answer on account of the fact that with the exception of the Holzwarth turbines, and perhaps one or two experimental machines under test, there are no prime movers of this type at present at work. The reply, therefore, must necessarily partake more of the nature of an expression of reasoned anticipation rather than of one based on proved facts, however near to their accomplishment various shades of opinion may be apt to place them. Well-known authorities in the turbine world have stated frankly that, pending further improvements in material, the commercial I.C. turbine is unlikely to be—nay, even will not be—forthcoming. Their justification may lie in Fig. 15 (U.S. Bureau of Tests), and in our last table showing the factors of safety in the type of rotor disc selected. It might lie in Fig. 4, though there is obviously another alternative to both. It is impossible to ignore the results obtained by Holzwarth however much one may disapprove of the application of valve mechanism to a rotary engine. The same mechanism excites no criticism in the reciprocating oil engine, yet when one regards the mass of cam shafts, push-rods and valve gear on a marine Diesel, one is tempted to ask whether that colossal multiplication of parts represents any approach to finality in oil engine design. The answer to the question as to the future of the I.C. turbine must necessarily depend very largely on the brake thermal efficiency obtainable.

Obvious as this remark may be, it needs a little explanation. Prices of fuel vary so greatly as between different countries, and brake thermal efficiencies may range from 15 to 17 per cent. to 30 to 34 per cent. in different types of heat engine, that to suggest any specific performance on the part of an unbuilt engine to compare with known figures of fuel consumption and fuel cost per horse-power, would be to go far beyond our original idea of restricting ourselves to recording the past and indicating the

‡ Particularly in the case of nickel-chrome blading.

principles involved in I.C. turbine design. What, however, should be shown in such a case, is the efficiency range within which the gas turbine must work in order to be comparable from the point of view of economy with steam or piston oil plants. With this object, the diagram in Fig. 16 shows the fuel cost in fractions of pence per brake horse-power

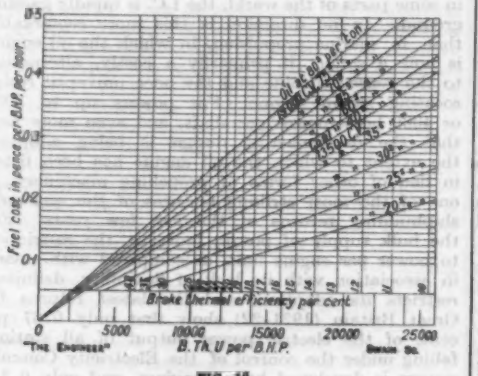


FIG. 16

per hour for machinery using oil of 19,000 or coal of 13,500 B.Th.U. per pound calorific value at varying brake thermal efficiencies, and from this our readers can form their own opinion. Thus, whereas with Diesel oil at 80s. per ton the fuel cost per horse-power ranges from 0.17d. with 35 per cent. B$\theta\eta$ to 0.19d. with 30 per cent., with coal at 30s. a B$\theta\eta$ of 15 per cent. gives 0.2d. per horse-power, while 17.7 per cent. also gives 0.17d., as in the Diesel at its upper limit of efficiency. The I.C. turbine, certainly if it works on the C.P. cycle, need not use high-priced Diesel oil, but may be fired with any boiler or refuse oil, and with the former at 65s. per ton an I.C. turbine must possess a B$\theta\eta$, lying between 23.25 and 26 per cent. in order to obtain fuel costs of 0.20 to 0.18. Similar comparisons can be made from this diagram to suit local fuel prices. It must not be overlooked that the ratio of fuel oil to coal price is usually much more nearly in the ratio of 1.6 to 1.7—the average "world price" being well under 1.6—and in few countries is the gap so great as it is in Great Britain. It is in the scope in foreign markets, where bulk fuel costs *on site* are greatly affected by the total weight of fuel to be hauled to its destination, where the I.C. turbine may find a ready opening.

For marine work, although it seems probable that an oil consumption of about 0.6 lb. per brake horse-power at the turbine may be obtained without difficulty, the I.C. turbine seems likely to be quite impracticable without utilising an electric drive. For producer or blast-furnace gas it would seem to have a very wide scope, and particularly in the case of coal carbonising plants, such as the large Holzwarth turbine was designed for. In this case, be it remembered, the turbine is a link in the chain and does not, as a marine engine would, require to stand on its merits for economy so much as for those of convenience of application, which, in this case, is all in its favour. Supposing that, neglecting the Holzwarth efficiency of 24 to 26 per cent.—though there is no reason why we should—but reasoning from Tables IV., XI. and XII., and without for the time being specifically defining either the nature of the cycle, or the cycle limits, or suggesting any particular system of operation, beyond remarking that designs to that end are known to exist, a brake thermal efficiency of 20 per cent. be considered as feasible without exceeding the limits indicated in our articles. It would seem to be indisputable that we should then possess a novel prime mover which would be materially more economical than a steam plant, and be unencumbered with the boiler and condensing plants and all that they involve, and while in efficiency it would fall distinctly short of the Diesel type engine, nevertheless the advantages of the turbine system, as opposed to those of the piston engine, and which have so clearly been proved in the case of steam turbines—advantages, for instance, such as ease of application, flexibility, light weight and small space involved—would seem to offer a very wide field, indeed, for such an engine, if only the difficulties which we have frankly referred to can be overcome. Bearing in mind the history of the evolution of either the steam turbine or the heavy oil engine, it may reasonably be considered that the position may be regarded optimistically and not otherwise.

Safety in Mines.

THE sixth International Mining Exhibition, which closed at the Agricultural Hall yesterday, included, as we have already mentioned, a considerable number of exhibits dealing with the investigation of mining practice and appliances from the point of view of the safety of the workers. These exhibits were collected together in the Gilbey Hall, and had been provided from the laboratories of practically all the technical colleges and research associations interested in the subject. The several institutions had separate stands, but it was noteworthy that, instead of there being any rivalry, as there naturally was in the main hall, in the Gilbey Hall everyone was for collaboration.

One of the most interesting stands was, perhaps, that of the Mines Department Experimental Station at Eskmeals, on which there was a very wide variety of apparatus. We noticed a large number of safety lamps, both flame and electric, and the apparatus used in testing their safety. The lamps have to withstand being dropped several times on to a wooden floor from a height of about 5ft. without suffering any damage. They are then placed on the floor and a heavy weight is dropped on them, while they must, of course, be proved unable to ignite an explosive mixture. In this connection it is noteworthy that the British standard wire mesh for safety lamps has been shown to be unnecessarily fine. There were, on the stand, samples of many gauzes that had been experimented with, ranging from some even finer than the British standard, which has an aperture of 0.00044 square inch and wire 0.0148in. diameter, to another with apertures of 0.0022 square inch and wires 0.024in. diameter. The latter gauze has been proved to be quite safe in the most explosive mixture of fire-damp, while it obviously will pass much more light than the standard gauze. The Mueseler chimney has also been tested exhaustively, and proved to be quite safe if the diameter of the opening at the top bears a definite ratio to that at the bottom, and this feature appears to be more important than the actual height of the chimney.

A piece of apparatus on this stand is used to dispel the fear, which some people have, that a coal-cutting machine may strike dangerous sparks if the cutter encounters stone. It consists of a wheel of hard sandstone, driven by an electric motor and surrounded by a box with glass windows. The box, the top of which is closed by a sheet of oiled paper, is filled with an explosive mixture, and a piece of steel is pressed up against the rotating wheel. The shower of sparks caused by grinding away the steel, even when it is fed up to the wheel most violently, entirely fails to explode the gases. The explanation is that no individual spark has time to heat the gas up to the ignition temperature, and that convection carries the gas away before it can be further heated by subsequent sparks. In order to demonstrate that the contents of the box really are explosive, two electric sparking points are arranged within. A spark between these points explodes the mixture and the paper cover is blown off. We were told that trials had been carried out in a somewhat similar apparatus to see if a wire heated electrically to redness would fire an explosive mixture of methane, and in this case also convection carried the gas away too fast for it to be exploded.

We witnessed in a dark room attached to this stand a fascinating experiment, which was devised to demonstrate the propagation of an explosion. A long glass tube was rigged up to represent a mining gallery, and after it had been exhausted of air, was filled with a 9 per cent. mixture of fire-damp—a highly explosive mixture. The mixture was lit at one end of the tube, and the flame could be seen gently travelling along for a distance of about a yard, when the whole column appeared to resonate like an organ pipe. The disturbance thus caused hastened the propagation of the flame, and it rushed to the end of the tube in an explosive manner. The turbulence is apparently an essential part of the explosion, but may be produced by other causes, such as pit props, or any obstruction in the gallery. The experimental apparatus is provided with means for measuring the speed of the flame.

The methods of carrying out a number of other researches, such as the estimation of moisture and ash in the mine road dust, and the determination of the ignition of coal dust, were also demonstrated on the Eskmeals stand, while there was an apparatus for testing electric bells. With this device it is possible to show that if the bell is provided with secondary windings that oppose the induced electromotive force, the sparking at the contacts can be reduced to a negligible quantity.

One of the most interesting pieces of apparatus on the adjacent stand of the University of Sheffield was a small explosion chamber for testing mining electrical apparatus in explosive atmospheres. It has a capacity of about 14 cubic feet and is modelled on the same lines as a larger one at the University, which is 7ft. cube, with a 4ft. cube annexe; that is to say, large enough to accommodate a complete coal-cutting machine. The chamber is made of wood with glass windows, and oiled paper safety doors.

The apparatus to be tested is charged with an explosive mixture and placed in the chamber in an explosive mixture. The gas used for making the mixture is true mine gas, obtained from a "blower" in a pit and compressed for convenience of transport into steel bottles. An electric spark is produced inside the apparatus under test, and if it is safe the resulting explosion is, naturally, not transmitted to the surrounding gas.

Some important experiments have been carried out in this chamber to determine the extent to which the flange joints of electrical switch cases may be spaced apart without fear of the transmission of an explosion from the interior, and a typical test was carried out for our benefit. The switch case is represented by two hemispherical castings of gun-metal joined together by 1in. flanges. Sparking points are provided inside the globe, and a connection is arranged with an indicating pressure gauge. The globe is filled with an explosive mixture and mounted in the chamber, which, in turn, is filled with gas and air. Apparatus is provided for sampling the mixture, so that it can be shown to be thoroughly explosive. In connection with the pressure gauge there is a travelling band of paper which gives three records—the pressure generated inside the globe, the moment of the spark, and time in fiftieths of a second. In the case of the experiment which we witnessed the flanges of the globe were spaced apart by $^{7}/_{64}$in., with the result that the flame of the explosion within escaped and fired the explosive mixture in the chamber. If, however, the gap between the flanges is reduced to $^{5}/_{64}$in. the flame cannot pass, as the adjacent metal absorbs too much of its heat. The pressure generated within the globe is, nevertheless, reduced to some 18 lb. to 20 lb. per square inch, as compared with about 100 lb. if the flanges are closed tight together. The result is that the casing can be made much lighter with the spaced flanges than when it is attempted to box in the explosion completely. The gap of $^{5}/_{64}$in. is quite safe even if the spark is fired close to the inside edge of the flange joint, but if it is assured that the spark takes place at the centre of the globe, the gap may be safely increased slightly.

On the stand of the Explosives in Mines Research Committee there was a model of the experimental gallery at Ardeer, which is used for testing permitted explosives. There was also a series of photographs of blown-out shots with permitted and non-permitted explosives that demonstrated plainly how dangerous is the after flame produced by the latter type. A Hopkinson horizontal impact bar, which was exhibited on this stand, has been modified for measuring detonation pressures. The detonation takes place at one end of the bar and the longitudinal vibrations thus set up drive off a pellet attached to the other end. This pellet is caught in a ballistic pendulum, so that its energy may be measured.

Another piece of apparatus is used to determine the period of time during which an explosive mixture of gas must be exposed to a flame before it will be ignited. The gas is contained in a small open-bottomed cylinder which travels in a circle, at a known speed, on the face of a plate. In one part of the track round the plate there is a small slot, and through it a tiny flame protrudes. As the cylinder passes by its contents are naturally exposed to this flame, through the opening in the bottom, and are exploded if the speed of passage is sufficiently slow. The firing is also naturally dependent on the heat of the flame, and the nature of the explosive gases, but ranges roundabout $^{6}/_{1000}$ of a second with a standard coal gas flame and a fire-damp mixture.

This same problem is also being investigated in the Sheffield laboratories of the Safety of Mines Research Board; but in this case the gas container is stationary and is separated from the flame by a steel band, with one small perforation, that travels across the mouth of the container like a cinematograph film.

THE ARCHITECTURE OF ENGINEERING.

REPLYING, in the course of a lecture on the Forth Bridge, to the charge that his great masterpiece was lacking in beauty of outline, Sir Benjamin Baker remarked that the question of an object's purpose and use must enter into any judgment of its artistic merits. "A Corinthian column," said he, "standing in the portico of a classic temple, is recognised at once as being useful and artistically beautiful; whereas if two pipes, shaped as Corinthian columns, were placed on the deck of an Atlantic liner to act as smokestacks, they would excite universal derision."

On the other hand, we cannot shut our eyes to the fact that too many engineering structures have been built, and are to-day being built, purely on lines of utility and without the slightest thought as to whether the finished structure will be inherently ugly or beautiful. If, as some would have us believe, the shades of the departed visit this earth and take a lively interest in its development, what would be the comment of Leonardo da Vinci upon some of the structures of this age of steel. "Great engineering," it would mutter, "but wretched artistry." Yet, there is good promise for the future, since the engineer and the architect are beginning to realise the bond which exists or should exist between them. The architect, however, should be careful never to interfere with forms which are determined by strict engineering considerations. In other words, he should never distort the general outlines as called for by the stress diagram. In a recent illustration in an architectural journal, the architect, in an endeavour to give a more graceful appearance to an arch bridge, has swung the columns of the spandrel subarches out of the perpendicular, and converged them to meet on the top of the main piers. Pretty? Graceful? Artistic? Well, possibly; but considered from the engineering standpoint, the result is positively excruciating.—*Scientific American.*

A RECORD was made recently at the Abitibi Pulp and Paper Works, Iroquois Falls, Ontario, when 500 tons of newsprint was produced in twenty-four hours.

Railway Matters.

THERE was, on the morning of the 28th ult., another case of a broken connecting-rod on the London and North-Western section of the London, Midland and Scottish Railway. The circumstances are being inquired into by the Ministry of Transport.

WE hear that Colonel N. H. Bingham, who was formerly assistant to Sir Henry Thornton in the work of the Great Eastern Railway, has arrived in Canada to take a position as one of the assistants to Sir Henry in the management of the Canadian National Railways.

AT the statutory meeting of the Great Eastern Train Ferries, Limited, on the 5th inst., it was said that contracts had been entered into for the necessary dredging at Harwich and for the removal of the terminal from Southampton and its erection at Harwich. It was hoped that a regular ferry service would be opened by September.

FOLLOWING up the paragraph in this column on the 1st inst. as to the grouping of the railways in the Irish Free State, it may now be noted that a joint committee of the Great Southern and Western and the Midland Great Western companies has been appointed to discuss the incorporation with those two companies—which have agreed to terms of amalgamation—of the Dublin and South-Eastern and other railways wholly within the Free State.

IT was stated in the House of Commons on the 4th inst. that during this year orders for eighty-seven locomotives, at a cost of £394,000, for the Indian State Railways have been placed, and the High Commissioner is now placing orders for ten more locomotives, at a cost of about £50,000. The High Commissioner has no authority to anticipate requirements, and in placing orders the Government of India is necessarily bound by its railway programme and by ways and means.

THE practice, first introduced on the North Staffordshire Railway, of making all compartments available for smoking except those labelled "Non-Smoking," is being abandoned on the South-Eastern and Chatham Section of the Southern Railway, in order that uniform custom in this matter shall prevail in that group. In view of the great increase in smoking among all classes, the idea that passengers might smoke in any compartment except those where it was specifically prohibited was a good one. But its universal adoption was essential.

THE tonnage of rails rolled in the United States last year was, according to the statistics of the American Iron and Steel Institute, the lowest, except in 1914, since 1908. Last year, 2,171,776 tons were rolled, of which 2,033,000 tons were made by the open-hearth process. The year of the biggest tonnage was 1910, when 3,636,031 tons were rolled, of which 1,751,359 tons were of open-hearth steel, and 1,884,442 tons of Bessemer. The loss of popularity by the latter process has been a feature of the American rail situation in recent years.

IN these days when so much is being said as to the comparatively high cost of railway fares, the practice of the London and South-Western Section of the Southern Railway may be noted. That company issues, from practically all its stations, tickets on certain days at a single fare for the double journey to a very large number of those stations which are within a day's return journey. The outward journey may be made by any trains, except the morning business ones, and all trains are available for the return journey. The result is that although the ordinary fares are 50 per cent. higher than they were prior to 1917, these cheap tickets are actually 25 per cent. less.

ANSWERING a question on the 4th inst., Mr. Ormsby-Gore said that the Secretary of State had given his approval to the construction of a new railway in the Central Province of the Gold Coast Colony. The new railway would start from Huni-Valey Station on the existing Sekondi-Kumasi Railway, and would run thence to Kade in the north-eastern portion of the Central Province, a distance of approximately 100 miles. The railway would be built departmentally by the Colonial Government, the estimated cost of construction being £1,134,000. Much of the necessary survey work had already been carried out, and it was hoped that it would be possible to start construction at an early date.

MENTION was made in this column on the 11th ult. of the loop on the Charing Cross, Euston and Hampstead tube railway not being a success. The authority for this statement was Mr. J. P. Thomas, the operating manager, who, in a paper, "Operation and Development of Urban Electric Railway Services," read at the Institute of Transport on November 18th, 1921, said that the loop in question had shown no advantage over the previous terminal arrangements, owing to the congestion of traffic at the single loop platform. Under the proposed extension to Kennington the loop will be dispensed with That, by the way, was what happened to the loop at Wood-lane mentioned in the same paragraph. It was no longer required when, in August, 1920, the Central London was extended to Ealing.

A COMPLETE scheme has now been drawn up for the establishment of local conferences of railway and trading representatives in this country. Some of the details are as follows:—That the function of the conference be to act as a conciliatory and consultative body without any coercive power, and that all resolutions of the conference shall be passed by agreement between both parties. The conference may consider: (i.) Any local matters of a general character affecting traders within the area, including (*a*) the service, conditions and charges for traffic by passenger train; (*b*) the service, conditions and charges for the collection and delivery of merchandise; (*c*) the service, conditions and charges for traffic by merchandise train; (ii.) dock charges and facilities. By agreement, questions of general principle may be discussed, but no resolutions may be passed thereon. All deliberations of the conference are to be without prejudice and not to affect the rights of either party or of any trader, or of the chamber of commerce, or of any representative body of traders concerned to apply direct to the railway companies or to the Rates Tribunal for a settlement of the question at issue.

Notes and Memoranda.

LECTURING at the Swansea Metal Exchange on "Peppery Blister in Tin-plates," Professor Edwards recently said that researches had led him to attrfbute this evil to the action of nascent hydrogen formed in the pickling process by the action of sulphuric acid on the steel sheets. His experiments had not yet gone far enough to enable him to prove his theory and eliminate blister.

THE National Federation of Iron and Steel Manufacturers reports that the production of pig iron in May amounted to 714,200 tons, compared with 652,200 tons in April and 407,900 tons in May, 1922. This is the highest output attained since September, 1920, when production amounted to 741,000 tons. The furnaces in blast at the end of the month numbered 223, an increase of seven during the month. The production includes 252,100 tons of hematite, 217,900 tons of basic, 158,800 tons of foundry and 44,100 tons of forge. The output of steel ingots and castings amounted to 821,000 tons, compared with 749,400 tons in April and 462,300 tons in May, 1922.

THE seriousness of fires on American ships due to spontaneous combustion in bunker and cargo coal has led the Department of the Interior to undertake a study of causes and means of prevention, results of which are given in Technical Paper 326, by H. H. Stock, just issued by the Bureau of Mines. A tabulation of casualties from fires on British ships shows that the number of fires caused annually by spontaneous combustion ranges between 50 and 100. The average number of American steamers totally destroyed by fire each year is over 60. In addition, about 140 vessels of miscellaneous types are destroyed, a total of 200 per year. Property losses by fires on ships run into the millions of dollars. Loss of life has been considerable. The portion of these totals attributable to coal fires has not been ascertained.

THE generally accepted theory of the igneous formation of marble, states *Nature*, rests on crude experiments made by Hall (1801–3), in which chalk was heated in a closed gun-barrel. In the April number of the *Journal* of the Chemical Society, Dr. M. Copisarow describes some interesting experiments, which tend to support an aqueous origin of marble. When solid calcium chloride and hydrated sodium carbonate, or a paste of precipated chalk and sodium chloride soultion were heated in an autoclave at 300 deg. at a pressure of 24 atmospheres for 8 hours, a compact mass of marble, capable of taking a high polish, was formed. The salts present facilitated the solution of the chalk or other form of calcium carbonate and the high-pressure conditioned crystallisation. When sodium sulphate was used with calcium chloride a compact mass of alabaster was formed.

AMMONIUM nitrate explosives, when fresh and properly detonated, are well adapted for use in coal mines that are not usually wet, states the American Bureau of Mines, Department of the Interior, in Technical Paper 333, just issued. They are not suitable for use in wet mines, for if the contents of a cartridge of ammonium nitrate explosive is exposed for only a few hours to the damp atmosphere the explosive may so deteriorate as to fail to detonate completely, because ammonium nitrate takes up moisture readily. The re-dipping of cartridges of ammonium nitrate explosives aids in protecting the contents against moisture, or moist air, and the cartridges should be so stored and handled as to preserve the efficacy of the paraffin-like coating. The explosives should be obtained in a fresh condition and purchased in such quantities as will permit of their prompt use. Experience at the Pittsburgh experiment station of the Bureau of Mines shows that ammonium nitrate explosives will usually detonate completely after storage for six months in a well-ventilated magazine.

AN investigation of a submerged peat-bog in the harbour of Rungsted, Denmark, by Dr. Knud Jessen, of the Danish Geological Survey, has revealed considerable changes in relative levels of sea and land in the neighbourhood of Copenhagen during the late-glacial period. About 260 m. off the coast, and at a depth beneath the surface of the sea of some 20 m., was found a fresh-water clay—"Dryas-clay"—containing land plants, and this was overlaid first by deposits containing, among other things, bones of a vole and of a wild pig; secondly, by peat containing oak, alder, hazel, &c.; and, finally, by sea-mud with cockle shells and recent sea-sand. The indications seem to be that, at the beginning of the late-glacial period, the sea was 18 m. higher at Copenhagen than now, and that elevation of the land took place later, so that at the end of the late-glacial period it stood at least 24 m. above its present level relative to the sea; this elevation persisted from the younger Dryas period till the Littorina submergence, which finally broke the land-connection between Seeland and Scania.

FURNACES in which powdered coal is to burn must be large enough, and be correctly shaped, so that the coal may burn completely without impinging on the brickwork, and must be provided with facilities for removing the ash. If the furnace is correctly designed, about 3 B.Th.U. per second may be liberated per cubic foot of combustion space. This rate of combustion is sometimes exceeded, but if it is much exceeded the coal will not be burned completely. In many furnaces the temperature is so high that the ash fuses, and on settling in the furnace collects in a continuous mass. It has become expedient in some furnaces to cook the ash before settling and so prevent it collecting in a continuous mass, though generally this is not done, and the ash collects either on the hearth, whence it is removed when the furnace shuts down, or it is removed as a liquid slag. The ash that does not settle in the furnace goes off with the gases, and care must be taken to see that it may not be deposited in the flues and so impede the draught. When a furnace previously heated by coal burned on a grate, gas, or oil is to be transformed into a powdered-coal fired furnace, the furnace may or may not have to be modified in design to suit powdered coal. Except for boiler furnaces, very radical alteration of design is unusual. At most, the change consists usually in enlarging the furnace. No furnace should, however, be fired with powdered coal without the advice of experienced engineers.

Miscellanea.

WHAT is regarded as the largest submerged bridge in India, measuring about half a mile long, was recently opened in Central India. The bridge, which has been erected across the Nerbudda, is situated between Bombay and Agra, and will be submerged only during high flood.

FOUR companies have recently been organised in Moravia, the leading agricultural province of Czecho-Slovakia, for the purpose of supplying the province with electric power. Plans include the utilisation of power from the Moravice and Dyje rivers. Work has already been started on some of the plants.

DURING holidays, states the *Machinery Market*, a student from the engineering section of Liverpool University will be carried on each White Star Line passenger steamer sailing from Liverpool to America this summer. The practical knowledge gained from an experience of the engines of a great liner under working conditions at sea is likely to prove invaluable to the students, many of whom will eventually become marine engineers.

POWDERED coal has been used as a fuel for making basic steel in open-hearth furnaces for several years, states John Blizard, Fuel Engineer of the Department of the Interior, in Bulletin 217, recently issued by the Bureau of Mines. Powdered coal has not, however, proved a successful fuel for making acid steel in the open hearth, probably because of too high a sulphur content in the coal.

A REPORT from the British Engineers' Association, Incorporated, which has undertaken the organisation of the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition, states that already over 75 per cent. of the space to be devoted to these exhibits in the Palace of Engineering at Wembley Park had been sold and allotted through the Association.

THE lives of the Witwatersrand gold mines have at one time and another been variously estimated. The life of the Crown Mines has, for instance, been calculated to be from 17 to 25 years; that of the City Deep, 28 years; and of Government Areas, 25 years. The life of the Village Deep has been estimated at 8 years. The duration of the period of milling operations must, of course, depend in large degree upon development results and the cost of working.

IN a paper delivered at the recent annual meeting of the Illuminating Engineering Society in Germany, Dr. H. Bunte referred to the changes in the constitution of the gas supplied occasioned by the lack of coal during the war period and after. The effect had been to produce a hotter and narrower flame, for which pre-war shapes of mantles were not well suited. It was necessary that the mantles should now be made of smaller diameter so as to ensure that the fabric was placed in the hottest part of the flame.

THE Quinze Power Company, Limited, has been incorporated by interests identified with the Northern Canada Power Company, with headquarters in Toronto, and a capital of 2,000,000 dollars, to develop the Des Quinze Falls on the Quinze River, Quebec. A contract has been let to Morrow and Bealty for the development of the first unit of 20,000 horse-power. The contract for the survey of the transmission line to the Porcupine gold area, 120 miles distant, has also been awarded. As a precaution against fire and to insure durability, the transmission towers will be of steel.

AT the British Motor Boat Club's Regatta, which will be held along the Chelsea Reach of the Thames on June 30th, one of the chief attractions will be a motor lifeboat of the Royal National Lifeboat Institution. The London public will have an opportunity of seeing, not only one of the latest and most powerful of its lifeboats, but what will actually be the first of a new type, the first British motor lifeboat built with cabin accommodation. This boat, which is now being completed at Cowes, is intended for the lifeboat station at Tenby, and the new type will be known as the "Tenby" type. It will have one of the new 90 horse-power engines which the Institution has recently designed for its motor boat fleet.

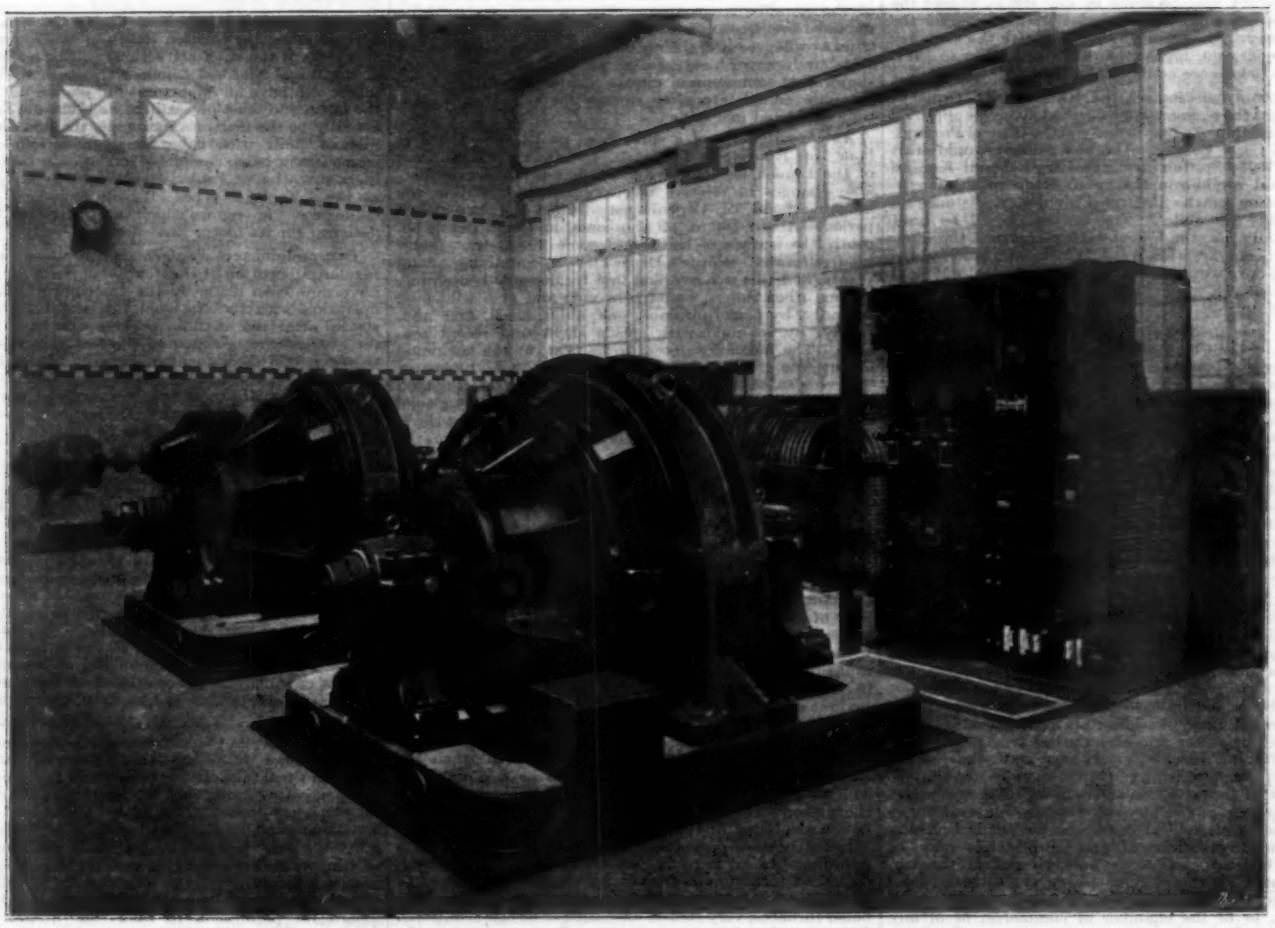
THE preliminary arrangements in connection with the regular publication of the *Journal of Scientific Instruments* have now been made by the Institute of Physics in co-operation with the National Physical Laboratory. The special attention of those workers who have new designs for instruments is called to the fact that the *Journal* is to serve as a medium of publication of detailed descriptions and critical surveys of the behaviour of such instruments. Original papers or laboratory and workshop notes dealing with the practical or theoretical aspects of scientific instruments should be sent to the editor, Dr. John S. Anderson, the National Physical Laboratory, Teddington, Middlesex.

SANDPAPER which permits of painted, varnished or enamelled surfaces being cleaned off damp has recently been put upon the market, according to the *Ironmonger*. Both the front and the back of the paper are waterproofed in a manner which prevents the paper from becoming soft when wet, while the abrasive material does not come off. Its chief aim is, of course, to keep down dust, and therefore it should prove particularly valuable where white lead has been used for painting. It costs more than the ordinary kind, but is said to last at least ten times as long. The paint which accumulates on the surface in the process of rubbing is easily washed off by means of sponge and water, and the paper thus lasts a long time.

ACCORDING to the *S.A. Mining and Engineering Journal*, the Victoria Falls Company contemplates the erection of another large power station on the Witbank coalfield. The plant will initially comprise three turbine-driven electric generating units, each having a capacity of more than 20,000 horse-power. The pressure at which energy will be transmitted to the Rand will be at from 120,000 to 135,000 volts, which is 50 per cent. higher than at present in use between Vereeniging and the Rand. The station may ultimately require as much as 750,000,000 gallons of water annually, and application will be made to the Water Board for permission to take that quantity from the Oliphants River. The fuel consumed at this power station will take the form of "duff" coal drawn from the neighbouring collieries.

ELECTRICAL INSTALLATION AT THE WORKS OF THE METROPOLITAN VICKERS COMPANY

SWITCHBOARD AND TRANSFORMERS



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THE ENGINEER.

JUNE 15, 1923.

Chemical Engineers and Their Training.

THE first annual corporate meeting of the Institution of Chemical Engineers was held at the Engineers' Club, London, on Friday, June 8th. Sir Arthur Duckham, K.C.B., who has been acting as President of the Provisional Council, was in the chair. In a report of the work that has been done since the decision to found the Institution on November 9th, 1921, the Council states that there have been 205 applications for membership, and of these, 114 have been accepted by the Council, the remainder being still under consideration. Mr. W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers, has been elected the first honorary member, in recognition of his work on behalf of the chemical industry in this country, and especially in the formation of the Institution. It has been agreed that the Institution shall take part in the British Empire Exhibition at Wembley, and the sum of £25 has been voted towards the chemical section. A satisfactory financial position was reported, and Sir Arthur Duckham was elected president for the coming year.

Following the routine business of the annual general meeting and the presentation by Mr. T. Campbell Finlayson of an excellent paper on "Industrial Oxygen," there was an informal dinner, at which a discussion upon that well-worn subject, the training of the chemical engineer, took place. It cannot be said that it carried us much farther towards a final decision. The same diversity of views with which we have been familiar ever since the subject first came into prominence in the early days of the war was expressed. There is, however, this important difference, that whereas hitherto there has been no one body which seemed in the position to take action, notwithstanding the existence of several societies connected with the chemical industry, there is now the Institution of Chemical Engineers, whose first important task will be to take counsel with the educational authorities of the country with a view to formulating a definite curriculum for adoption in our universities. Chemical engineering as such has advanced considerably since the early days when the discussion seemed to revolve around the conundrum whether a chemical engineer was a chemist with engineering knowledge or an engineer with chemical knowledge. The chemical engineer is now a recognised entity, and the Chemical Engineering Group of the Society of Chemical Industry is working closely with the new Institution, which is determined to give him a status equivalent to that of the mechanical engineer, or the civil or electrical engineer. It is hoped that the Council will have reached an agreed course of action in this matter of a curriculum for the training of the chemical engineer before the next annual meeting. Many leading chemists and chemical engineers in this country have been paying visits to America and Canada during the past two years, and their opinion of the methods of training adopted in American universities, in connection with chemical engineering, is that a course has been adopted which would utterly fail in this country. These opinions crystallise into the statement that chemical engineering students in American universities are over-trained, and in consequence are little practical value outside. It is not suggested that the curriculum in America is bad for the American student as such, but the warning is given to provide against an undue tendency to adopt American methods outright in the stage of development in this matter which we have now reached in this country. Despite this criticism, there seems to be a greater demand upon the American universities for chemical engineers than can be satisfied. Chemical engineering students in America and in Canada are, according to reports, snapped up even before they have completed their full course. There is a sort of waiting list of employers who apparently find out the capabilities of the students and book them for the time when they leave. Those who are going most deeply into this problem in this country are of the opinion that our industries, equally, will be able to absorb all the chemical engineers that our universities can turn out for a long while ahead, and thus it is that interest is being shown in certain new appointments which are pending. The Ramsay Chair of Chemical Engineering, for instance, is shortly to be filled, and there is, also, the establishment of a Chair of Chemical Engineering at Liverpool. Bearing on this aspect, some definite views are being expressed as to the type of man to be selected for professorships in these days. It is even suggested that our professors need training as well as the students, although, of course, in a different way. The complaint is that too many of them are purely theoretical and completely out of touch with the practical side of the industry, and it is urged that younger men—with the somewhat anomalous qualification that they should have many years' practical experience—should be selected. All this, however, suggests a definiteness about the whole problem of the chemical engineer and his training which has not existed hitherto, which may be traced to the work of the Chemical Engineering Group of the Society of Chemical Industry, a work which is now to be carried on more actively, because of greater freedom, by the Institution of Chemical Engineers. One most important point which arises is the attitude of the industry towards this educational aspect. It is, put plainly, that we can never hope to rear chemical engineers unless industrialists come in and help, somewhat on the lines of American employers, by giving facilities for students to secure practical training in the works, and also by sending their works managers and others into the universities to lecture and inform the authorities and the students as to the exact requirements.

It is a satisfaction to know that we have at last got beyond the region of talking that has lasted so long. The whole question is now to be taken up actively by the Institution of Chemical Engineers with the education authorities of the country. Notwithstanding that Sir Arthur Duckham, who has been re-elected President of the Council for the coming year, has expressed the opinion that the formation of this Institution will be the last straw in the establishment of new organisations of this type, it is quite clear that such an Institution has long been needed in the chemical industry. The hopes that have been so frequently expressed as to the co-ordination of the many existing societies in that industry do not appear to be much nearer consummation; hence, the more progressive members on the engineering side have been compelled to break fresh ground. Of the success of the new Institution there can be little doubt. If, in the end, it leads to greater activity on the part of the older bodies, and some sort of fusion of interests is brought about as a consequence, so much the better. In the meantime, a very definite programme has been mapped out, and a large field of work is presented.

Popular Knowledge.

QUITE recently we found occasion to discuss the lack of adequate diffusion of scientific knowledge among trained and experienced engineers. To-day we would draw attention to another aspect of the lack of adequate diffusion of knowledge—a lack which is only slightly less important, but

even more difficult to remedy. We refer to the great and, it would almost seem, growing lack of knowledge of engineering matters among even the well-educated members of the general public. At first sight, one would be disposed to ask, "What does it matter?" but on consideration we shall find that it matters a great deal. For it is, in the first place, the general public which, in one way or another, must find the funds for the work of the engineer. In ordinary commercial and industrial life the gap between the technical man and the public has, at present, to be bridged by a class of financiers whom the engineer must first satisfy or convince of the soundness of his project and who then proceed to obtain the financial support of the public. But even the better class of company prospectus is not a sound basis for the technical education of the public, and consequently unsound projects are as often readily financed as really sound and wise undertakings. This is a loss to the nation as well as to the engineer, who depends for satisfactory and profitable employment, in whatever capacity, on the growth of really sound and profitable undertakings and who suffers, sometimes even more acutely than the deluded shareholder, if he has been induced to devote his time, energy and reputation to anything like a "wild cat" scheme.

Beyond ordinary business undertakings, however, there is a very large class of engineering matters which are the concern of the public in a wider sense; these are governmental and municipal undertakings, or schemes which involve some form of public franchise, such, for example, as electric light and power schemes, docks and harbours, &c. Here an intelligent understanding of what is involved would be of the greatest possible advantage in enabling the public—the taxpayer or the ratepayer—to form an intelligent judgment above the clamour of the politician and the partisan advocate for or against. There is, for instance, a widespread idea that utilisation of water power for engineering purposes is necessarily bound up with interference with naturally beautiful scenery, which is frequently described as "vandalism." Actually, there is frequently a gain rather than a loss of picturesqueness by the establishment of reservoir lakes, and in any case it is a serious matter to hinder the proper utilisation of the natural resources of a country in order to conserve a small piece of romantic scenery. Yet important hydro-electric schemes in Scotland have been seriously delayed or even entirely prevented by unintelligent public opposition. Public opinion on engineering matters, however, is often required to give positive support, not merely to refrain from unwise opposition. There are large schemes whose realisation would mean much to the industrial future of the country which can never be achieved without active support from public opinion. Such schemes may mean the investment of great sums of public money or the granting of important and far-reaching rights. In either case the matter generally reaches the parliamentary arena and often becomes a party matter, or is, at least, made a local issue at an election. In such a case, upon what basis can a sound public opinion be formed? In actual fact, as matters stand at the present time, it is, for the majority of the public, merely a choice of blindly believing their favourite speaker or, more frequently, their favourite newspaper, and voting accordingly. Signs are not wanting that the need for the education of public opinion on matters of engineering interest has been appreciated. At least two of the great daily papers have weekly or bi-weekly columns or supplements devoted to engineering subjects. These are, no doubt, very useful, but it sometimes seems that they are not sufficiently technical for the engineer, but still too technical for the general reader. No doubt it is extremely difficult to write of technical matters in such a way as to be not only intelligible, but to make an appeal to the interest of the general reader. Yet some degree of interest in engineering matters is almost universal; what boy is there who is not more or less interested in seeing "how it works," whether "it" be a motor car or a locomotive? Indeed, the wide spread of automobilism serves as a distinctly educative influence in regard at least to mechanical matters; it is, however, too narrow a field unless it is widened by judicious stimulation of these interests so as to extend them to other fields. There are, of course, some journals which, in part at least, devote themselves to giving really popular accounts of engineering matters, whether these be machines or processes of manufacture or wide projects, such as great bridges or canals. These also are eminently useful, and so are the host of popularly technical books—mainly intended for boys—dealing with most branches of technology. None the less, there is room and need for much greater development in this direction; it is a demand upon the engineer as well as upon the public.

We live in times which, quietly and unostentatiously, but none the less really and fundamentally, are dominated by the engineer—using that word in its widest sense. The vital activities of civilisation could not act but for the proper working of hundreds of appliances and organisations of an engineering character. The nation that lives by these things must surely, if it is to live rightly and intelligently, desire to understand something of them. On the other hand, the engineering profession owes it to the public to provide the information in the easiest possible form. The profession, in fact, owes this, not only to the public, but to itself. That competent and busy men should shrink from "wasting" their time on giving popular expositions of their work is, in itself, natural enough. A few of them only, indeed, possess the somewhat rare gift of exposition which such work demands. It becomes, therefore, all the more the duty for those who can, to "do their bit" in assisting the education of the general public in engineering matters. It is far from being a waste of time; rather is it a fruitful task whose reward is sure.

The Operation of Water Gas Plant.

THOSE engineers whose particular sphere does not bring them into contact with the production of domestic and industrial gases would probably be surprised to learn that in this country alone no less than some 25,000 million cubic feet of water gas are made use of per annum, and that the world's output of the same gas reaches the enormous total of 120,000 million cubic feet, or, to speak in modern units, approximately 360 million therms. Such figures are amply sufficient to emphasise the importance of the process, and when, in addition, it is recalled that the coke consumed in this country for manufacturing water gas runs into half a million tons each year, it is apparent that no efforts should be spared to raise the efficiency of existing methods above their present none too satisfactory level. As an indication of the comparative efficiency of the various standard processes which are commonly employed for gas manufacture, it may be mentioned that with coal gas generation in the time-honoured horizontal retort, the thermal efficiency of gas production averages 53 per cent.; with the modern vertical retort in which the coal charge is subjected to steaming, the figure is 55 per cent.; whereas in the production of blue water gas, it reaches barely 50 per cent. The main defect of the water gas process is that during the necessary period of heat replacement—an operation commonly known as the "blow," in contrast with the gas-making or steaming period called the "run"—a considerable amount of sensible heat and a certain quantity of combustible gas is sent direct into the atmosphere and lost. In the latest practice the blow gases have been utilised for the production of steam in waste-heat boilers, a development which has not only added very measurably to the efficiency of gas production, but which has provided a means for making the process "self-steaming," thus eliminating the necessity for separate boiler installations.

Apart from waste heat recovery, however, there can be no question that by attention to some of the less-evident considerations there is plenty of room for improvement, particularly so far as the fuel consumption per unit volume of gas produced is concerned. The average practical gas engineer is perhaps too much a slave to convention and to his rule-of-thumb methods to take the initiative and unravel some of the more highly technical problems for himself; moreover, he usually lacks the necessary scientific apparatus for conducting experiments in the nature of research work. He is, however, quick to grasp the significance of the work conducted by those more or less academic institutions which exist for the solution of his scientific problems, and there is little doubt that there has been something in the nature of a technical renascence in the gas industry during the last decade since it has enjoyed the co-operation of Leeds University and the Fuel Research Station at East Greenwich. From time to time an attack is made at these two centres upon some process or other which shows promise of improvement, and quite recently the Fuel Research Board published a report which deals with a series of experiments which have been conducted in an endeavour to determine the most efficient method for operating water gas plant. It should be said at the outset that the report has nothing whatever to offer in the way of striking departures from present practice; rather does it deal with details such as the effect on efficiency of modifications in the "blow and run" cycle, depth of fuel bed, &c. It is interesting to note that there is one fundamental difference in the principle of operating water gas plant in this country and in Germany. Over here we invariably employ a deep fuel bed and a "blow" of comparatively long duration, whereas the German Dellwik system embodies a shallow fuel bed and a short and sharp "blow." At the Fuel Research Station both of these systems have been experimented with in an attempt to determine which is the more efficient. The meticulous care with which every detail has been recorded speaks highly for those who have been in charge of the work, and it is a striking fact that so far as net efficiency is concerned, there appears to be very little to choose between the English and German systems.

Obituary.

WILLIAM BRUCE THOMPSON.

THE death is announced as having taken place on the 8th inst., at Dundee, of Mr. William Bruce Thompson. Mr. Thompson, who was about eighty-six years of age, was born at Broughty Ferry in 1837. He served his apprenticeship as an engineer in Dundee Foundry, and afterwards went to Russia, where he remained for several years. Returning to Dundee in 1866, he began business as an engineer and shipbuilder in Tay Foundry. Two small vessels were built and transported over land—for the foundry was some distance from the river—and successfully launched.

In 1874 he started the Caledon Shipyard, the first vessel built in which was a composite steam yacht for the Earl of Caledon, who consented to give his name to the yard.

The business flourished, and many notable steamers and sailing ships were built in it. In 1881 Mr. Thompson extended his interests to the Clyde, and for five years carried on a yard at Whiteinch, where he built some very large and handsome steel ships. He also carried through a number of important salvage operations. Under the firm name of W. B. Thompson and Co., Ltd., the Dundee business was conducted until 1896, when the yard and Lilybank Engine Works were taken over by the present firm, the Caledon Shipbuilding and Engineering Company, Limited, of which Mr. Thompson was a director.

Literature.

The Design of Masonry Structures and Foundations. By CLEMENT C. WILLIAMS. McGraw-Hill Book Company, Inc., New York and London. 1922. 25s. net. 550 pages.

MR. WILLIAMS includes under the term "Masonry" all forms of engineering concrete construction as well as brick and mason's work. The scope of his book is, therefore, wider than the title would indicate to English readers. He is Professor of Civil Engineering in the University of Kansas, and he has written primarily for the benefit of engineering students. The first four chapters, which deal with the use of masonry and concrete generally in engineering structures, are more elaborate and cover the ground far more completely than does the ordinary text-book, and the parts dealing with concrete aggregates and mixtures are particularly valuable. Some risk of confusion in the mind of the reader is, we think, likely to arise from the use by the author of two distinct methods for denoting concrete mixtures. On page 79 the definition of proportions of aggregate and cement is ambiguous, and it is not clear whether by 6 to 1 concrete the author means 6 parts of mixed aggregate—coarse and fine together—or the mixture commonly denoted 1 : 2 : 4. Elsewhere in the book, notably on pages 81 and 84, it is clear that Mr. Williams intends 6 to 1 concrete to denote a mixture of 1 : 2 : 4 or 1 : 2½ : 3½, and so on.

One pleasing characteristic of the author's work is his insistence on the desirability of due consideration being given to the æsthetic features of design. He writes: "There is an increasing demand in the design of engineering structures to secure, not only stability and economy, but something of elegance, grace and beauty in addition. Since good architectural treatment can be secured with but slight, if any, increase in the cost, it is appropriate that this phase of design should be given special attention in planning masonry structures." His attempt "to keep in mind the æsthetic features of design in the selection of illustrative examples and to mention briefly the underlying principles of good architectural treatment whenever they could be formulated" has, we think, been attended with success, and both in the introductory chapters and in the brief refer-

ences to examples of construction there is sound comment on good and bad examples of architectural treatment.

The chapters on particular forms of masonry and concrete construction are necessarily little more than introductory sketches to studies which are dealt with in detail in more specialised works. Among the subjects covered are arches, dams, retaining walls, bridge abutments and piers, concrete viaducts, culverts, storage bins and foundations. A chapter on forms and falsework for concrete is particularly good, as is also that on masonry and concrete arches. As a sound guide to principles of construction Mr. Williams's work is to be commended.

Scottish Canals and Waterways. By EDWIN A. PRATT. Selwyn and Blount, Limited, London. 1922. 10s. 6d. net. 299 pages.

EDWIN PRATT, who died on October 27th, 1922, at the age of sixty-eight, was a voluminous writer on transport problems. His contributions to the literature of railway economics are well known. By profession a journalist, he acquired an extensive and specialised knowledge of transport problems, which he utilised in his numerous publications. Many of these, although having no pretensions to be classed as literature, have a permanent value as historical records and as summaries of facts and statistics. The volume before us contains accounts of the Scottish canals, and is particularly full and valuable in the historical sections. The descriptions of the Caledonian and Crinan canals, both State-owned, the Forth and Clyde Navigation, the Monkland and the Union canals, all of which are railway-owned, are of permanent value for reference. In addition to the descriptive and historical portions of the work, the author dealt fully with the several schemes which have been propounded from time to time for the improvement or reconstruction of the Caledonian and Crinan canals and for the construction of a mid-Scotland ship canal. He regarded the proposed Crinan Ship Canal as having a first claim on public attention at the present time. Next to that project in order of importance he placed the reconstruction of the Caledonian Canal. With regard to the railway-owned canals of Scotland, he was of opinion that no occasion had arisen for their enlargement or improvement, and, on the subject of the mid-Scotland ship canal schemes, was strongly in favour of the Loch Lomond route in preference to the alternative scheme which is known as the "direct route" canal, but as an alternative to the construction of the mid-Scotland ship canal he suggested that an enlarged Caledonian Canal might avoid the necessity of building the former.

The arguments adduced by Mr. Pratt in support of the costly schemes he favoured are obviously open to criticism, and the whole subject is of a highly contentious nature, and at the moment has little more than an academic interest. The volume contains an excellent bibliography of the subject, and is illustrated by plans and sections which are sufficient to elucidate the text.

Metals and Metallic Compounds. By ULICK R. EVANS, M.A. To be completed in four volumes. London: Edward Arnold and Co. Vol. I.: Introduction, Metallography, Electro Chemistry, 21s. net. Vol. II.: Metals of the "A" group, 18s. net.

THE title of this work is somewhat misleading, as it actually deals with most sciences, and appears to be intended for a text-book on inorganic chemistry. For whom Vol. I. is written it is difficult to say, but one may surmise that it might appeal to students who want to learn modern scientific phraseology. The start is made with fifteen pages purporting to give "every chemist a clear idea about electricity," including "thermo-electricity." A slightly longer section follows, covering general and physical chemistry, states of matter, mineralogy, X-ray lattices of crystals—all within 54 pages! Analytical chemistry and atomic weight determinations are given in ten pages, thermo-chemistry six, &c. &c. Maybe Vol. I. is intended to cover general science as well as metallurgy and electro-chemistry, but the task of compressing it all into less than 500 pages octavo of boldly printed matter has evidently been too much to permit the author to do himself justice. The chapters referring to metallurgy in all its aspects are lucid enough, and give a good picture of the present state of that science. One can say the same about those relating to electro-chemistry, which are followed by tabloid doses on corrosion, radio-activity, &c. Such is the wide scope of Vol. I., which no doubt represents a great deal of work. But a book, like a picture, should have a frame beyond which it should not extend, and to attempt too much is rather worse than the reverse procedure.

In Vol. II. the author presents a text-book on inorganic chemistry of quite the ordinary kind. It has a rather attractive feature, viz., it gives details of manufacturing processes more fully than is usual. This is coupled with a discreet selection of the chemical compounds described, which enables the author to draw a picture with a good deal of detail without being monotonous. The book cannot replace the larger text-books of the chemist, but it fills a long-needed want—viz., it gives a grasp of practical technicalities to the academically educated student, and it implants a certain amount of academic caution in the purely technical one. In as far as the specialised treatment of the separate elements in Vol. II. goes, it must be pronounced excellent, and it makes one wish that the book had been devoted to this object only.

The printing, paper and illustrations are very good, and the volumes are of a handy size for use during study.

SHORT NOTICES.

Pioneer Railway Engineering. By H. Stringer, B.A., A.M. Inst. C.E., Resident Engineer, Pekin–Mukden Railway. London: H. F. and G. Witherby, 326, High Holborn, W.C. 1923. 9in. by 8in. 269 pp., including 38 numbered blank pages interleaved throughout the book for notes by the reader, 6 folding plates and 48 other illustrations. 12s. 6d.—The opportunity to review this work reminds us that a few years ago we had occasion to look into the administration of the Pekin–Mukden Railway, and were struck by the low ratio of the expenditure to the gross receipts, which in 1914 was as low as 27 per cent., even although 7 per cent. of the receipts were spent in betterments. The explanation is to be found in the fact that the line was constructed by British engineers with material mainly from the Old Country, and many members of the administrative staff are British. One such is the author of the present work. The title of the book explains it, and we need only add that its field covers, not only China, but has references to practices in India, Malay, South Africa, Nigeria, Japan, &c. The objects that the author has kept before him are (1) to study and lay emphasis upon the economics of a branch of engineering of very great importance to the world's progress; (2) to concentrate, for the use of the pioneer engineer, information now scattered throughout many standard works; and (3) to bring together, from the note-book of the executive engineer, those variations in practice decreed by climatic and economic conditions prevailing outside Europe. He has been very successful in the pursuit of these objects, and has written a book which is very welcome in a relatively unexplored field.

Indian Engineering. By William Lumisden Strange, M. Inst. C.E. London: George Routledge and Sons, Limited. 1923. Price 12s. 6d. net.—This book, which runs to just over 200 pages, consists of a collection of articles, which originally appeared in *Indian Engineering* and which have been specially revised for the present purpose. It is divided into four main parts, viz., Irrigation, Water Supply, Roads, and Buildings; Part I. being subdivided into thirty-five chapters, Part II. into six, Part III. into four, and Part IV. into two. It is explained in an introductory chapter that the chief matters discussed in the book relate, to principles, "which, being unalterable, govern design," although the way in which constructed works give effect to them may vary. "If," says the author, "the engineer grasps these principles and applies them properly, he will build his works on sound foundations and rest assured of their success." Although Indian conditions are specially taken into account, the author points out that the principles described are of world-wide application. There is much of considerable value to the student in the book, but its utility would certainly be enhanced by the provision of an index.

The Modern Ironfoundry. By Joseph G. Horner. London: Henry Froude and Hodder and Stoughton. 1923. 15s. net.—This is a comprehensive work dealing with the whole subject of ironfounding, chiefly from the point of view of operation rather than equipment, although the latter is not neglected, while a separate chapter is devoted to a description of the design of a foundry. The author begins with an explanation of the different classes of iron used for castings, and the methods by which they can be identified. Cupolas and their working are dealt with at some length, and there is a chapter on fans, blowers, ladles, &c. The body of the book is devoted to descriptions of the procedure adopted in making typical castings, together with the appliances used, and is well illustrated by line drawings. There is a special chapter on die casting. Taken altogether, the volume should prove very useful to anyone who proposes to set up a general ironfoundry.

The Prevention of Vibration and Noise. By Alec. B. Eason, Assoc. M. Inst. C.E., A.M.I.E.E. London: Henry Froude and Hodder and Stoughton. 1923. (Oxford Technical Publications.) Price 15s. net.—This volume is a glorified bibliography divided into a number of chapters. A list of the authorities the author has consulted occupies six and a-half pages of close type. The first half of the book is devoted to brief, sometimes very brief, summaries of articles, of reports, and of books dealing with vibration; in the second part, noise is handled in the same way. The author appears to have made but little critical examination of his authorities, and he leaves us with little or no impression of his own ideas upon the subjects under his hand. By close condensation he has compressed a great deal of matter into a small compass, and as a jumping-off place for a fuller study of the subject, his work should prove of great value; whilst the busy man may hope to find in it without much trouble the facts he is in search of.

Railway Signalling: Automatic. By Francis Raynar Wilson, Assistant Engineer, Victorian Government Railways. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. 6¼in. by 4in. 116 pages, 75 illustrations. 2s. 6d.—This is one of Pitman's excellent primers. It is offered as "an introductory treatment of the purposes, equipment and methods of automatic signalling and track circuits for steam and electric railways." The author has had sixteen years' practical experience in this sphere at home and abroad, the last eight of which have been on the Melbourne electrified lines. The book, which is intended for beginners in the art of automatic railway signalling, may be safely commended to them, and to that large body of amateurs of our railways who are not devoted exclusively to locomotives.

The Radio Experimenter's Handbook. By Philip R. Coursey. London: The Wireless Press. Price 3s. 6d. net.: Part II. of Mr. Coursey's volume, "The Radio Experimenter's Handbook," is a well-prepared and useful volume. In seven chapters the author deals with the measurement of high-frequency currents and voltages, fundamental formulæ and data, aerials and tuning circuits, tuning coils and inductances, condensers, valves and their constants, and simple measurements with valve circuits. Mr. Coursey's books on radio work are always instructive, and we have no hesitation in recommending the present volume to amateurs and others who are interested in the experimental side of wireless telegraphy and telephony.

BOOKS RECEIVED.

The Twenty-second Financial and Economic Annual of Japan, 1922. Tokyo: The Government Printing Office.

A Treatise on Engine Balance Using Exponentials. By P. Cormac. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 21s. net.

Patternmaking. By Edward M. McCracken and Charles H. Sampson. London: Scott, Greenwood and Son, 8, Broadway, Ludgate, E.C. 4. Price 10s. 6d. net.

Schedule "A" and House Duty Assessment. By J. Stanton. London: J. Stanton, Rating Surveyor, 12, King's Bench Walk, Temple, E.C. 4. Price 27s. 6d.

Structural Drafting and the Design of Details. By Carlton Thomas Bishop. Second edition. London: Chapman and Hall, 11, Henrietta-street, W.C. 2 Price 25s. net.

The Properties of Engineering Materials. By W. C. Popplewell and H. Carrington. London: Methuen and Co., Limited, 36, Essex-street, W.C. 2. Price 25s. net.

The Working and Design of Gas Producers. By J. W. Spedding. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W.1. Price 2s.

The Design of Steam Boilers and Pressure Vessels. By George B. Haven and G. W. Swett. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 20s. net.

By-product Coking. By the late G. S. Cooper. Second edition, enlarged and revised, by Ernest M. Myers. London: Benn Bros., Limited, 8, Bouverie-street, E.C. 4. Price 12s. 6d. net.

State of California, Department of Public Works, Division of Engineering and Irrigation: Bulletin No. 4, *Water Resources of California: A Report to the Legislature of* 1923; Bulletin No. 5, *Flow in California Streams*, being Appendix A to Bulletin No. 4; and Bulletin No. 6, *Irrigation Requirements of California Lands*, being Appendix B to Bulletin No. 4. Sacramento, California: State Printing Office. 1923.

PORT IMPROVEMENTS IN COLOMBIA.

CONSIDERABLE importance attaches to the work now in progress at the Boca de Ceniza and Magdalena River—Colombia—for opening and maintaining a navigable channel leading from the Caribbean Sea to Barranquilla, thus making the port available for vessels of up to 30ft. draught. The attempt to solve the difficult problem of improving the bar channel is the third of its kind, the first having been submitted in 1908 by Professor L. M. Haupt, and the second in 1914 by Mr. Julius Berger. In both projects curved jetties were proposed in order to connect by a single channel the deep-river channel inside the mouth with a deep and narrow valley in the sea-bottom off the coast to the eastward of the river mouth. The Haupt project proposed to accomplish this by the use of a single curved jetty on the east side of the proposed channel location; while the Berger plan called for the addition of a second curved jetty along the west coast of the proposed channel, with a width between the jetties of only about 440 m., say, 1444ft., less than the width in the river where the desired depth is maintained.

The present operations provide for the control of the river's flow by artificial works to concentrate and direct the passage of the water, and comprise, *inter alia*, the erection of two protecting jetties east and west respectively 2225 m.—7300ft.—and 2390 m.—7842ft.—in length, at a cost of 3,880,000 dollars—£776,000. They will be built in fairly shallow water. Further operations to be undertaken include some heavy coastal construction and protective work inside the mouth of the river; while other work will be required at intervals along the west bank from Barranquilla to the mouth to prevent further erosion and to hold the channel in about its present position. The entrance to the Cienago de Mayorquin will be closed by a permeable dam which will prevent the formation of a current through it, and will allow further silting to the west in seasons of high water.

In order to carry out the dredging operations as speedily as possible, the contractor-engineers, Messrs. Black, McKenney and Stewart, of Washington, U.S.A., have purchased and fitted out a sea-going hopper-type dredger which has already commenced work upon the channel over the bar. They have also purchased a larger sea-going hopper-dredger from the Panama Canal authorities, and when the latter has been refitted it will be employed to proceed behind the smaller dredger for the purpose of taking the channel down to its full depth of 35ft. While the dredging is in progress the construction of the jetties will proceed with the idea of protecting the channel from filling up and remaining the menace to commerce that it now is.

The conversion of the mouth of the Magdalena by means of a navigable channel through the shoals at the entrance to the river is expected to bring great economic prosperity to Colombia, since the world's commercial fleets will be able to go direct to Barranquilla. The total estimated cost is placed at nearly 6,000,000 dollars—£1,200,000—and the work will take five years to complete.

The Yarrow Land Type Boiler.

THE Yarrow water-tube boiler stands well to the front among the various boilers on account of the excellent results it gave in naval service during the war, while recent experience with similar boilers of a modified continental form on large Atlantic liners has proved equally satisfactory. Since its inception in 1885, the use of the Yarrow boiler, both afloat and ashore, has steadily increased, and its most recent development in connection with the economic generation of steam in large electric power stations is of special interest.

In designing a boiler to meet the particular needs of power station work, the firm was enabled to make use of its valuable records of experimental and research work carried out at Scotstoun, and the following were some of the points which were kept in view:—It was desirable that the design should be as simple as possible, and that ample provision for examination and access to the boiler should be made. The straight generating tubes of the Yarrow boiler are easily examined and cleaned, and the number of bolted joints and inspection doors is reduced as far as possible. Apart from the boiler mountings, which are naturally bolted to the boiler, the only other bolted joints in the design adopted are the manholes at each end of the steam drums and the water collector. Flexibility in operation was also required in order that the boiler when under steam might meet sudden and considerable overloads, and for this reason the straight and nearly vertical tubes were particularly advantageous, because the circulation in such tubes is rapid and enables unexpected and high overloads to be met without risk. The efficiency of the final design is enhanced by the large radiating surface exposed to the furnace, which increases the overall efficiency of the boiler owing to the large amount of heat absorbed by this surface. In order to secure an even greater overall efficiency, pre-heating of the air delivered to the furnace grate is adopted, tubular air heaters being used.

THE DUNSTON BOILER.

The first large boiler designed in accordance with the foregoing principles was that supplied to the Dunston power station of the Newcastle-upon-Tyne Electric Supply Company, Limited. This boiler has now been in successful operation for some months, and we are indebted to the Newcastle-upon-Tyne Electric Supply Company, Limited, to Messrs. Merz and McLellan, the consulting engineers to the company, to whose approval the installation of the boiler was made, and to the builders, Yarrow and Co., Ltd., Scotstoun, West Glasgow, for permission to give some details of the boiler and the trial results.

The drawing reproduced in Fig. 1 illustrates the general arrangement of the boiler at Dunston. It will be seen that it is of the Yarrow straight-tube type, fitted with a superheater and air heaters, the elements comprising a steam drum 5ft. in diameter and four water drums. The steam drum and the water drums are connected by 1¼in. cold-drawn steel tubes, which are expanded and bell-mouthed at each end by pneumatic power in accordance with the usual practice in this type of boiler. The outside water drums are 30in. in diameter and are connected to the steam drum by twelve rows of tubes, while the two drums nearer the fire, which are 23in. in diameter, are joined to the steam drum by four rows of tubes. The total evaporating surface of the boiler is 9100 square feet, of which 2135 square feet are provided in the two tube nests on either side of the fire and 6965 square feet in the outer nests.

At each side of the boiler between the two nests of tubes one-half of the superheater is installed, the steam passing first through one and then crossing by a pipe to the other.

The superheater, which has a heating surface of 2000 square feet, is composed of a number of U tubes, 1¼in. diameter, which are expanded and bell-mouthed into a circular drum, access to the tube ends being obtained from inside the drum which may be entered by a manhole in the usual way. The superheater is of the self-draining type, and is designed so that the steam makes two passages through each part, or four passages in all. The drop in steam pressure through each part under the highest rates of evaporation does not exceed 1 lb. per square inch.

A feature of the boiler is the large combustion space of 1800 cubic feet, and the extent of the evaporating surface which is exposed to the direct radiation of the fire. An examination of the combustion chamber after the boiler had been in commission for some months showed that the tubes had remained quite straight.

The Dunston boiler is fitted for coal firing, and two chain grate stokers were supplied by Edward Bennis and Co., Limited. The width of each grate is 8ft., and the total grate area 220 square feet. Both grates are provided with closed riddling pits to seal the space which receives the heated air supply. It will be seen from the sectional drawing in Fig. 1 that the air heaters are placed in the uptake. They are of the tubular type, and contain 1504 tubes, 8ft. in length and 2¾in. external diameter, the combined heating surface being 8631 square feet. The gases pass through the inside of the tubes, and the air to the grates is heated by passing over the outside of the tubes. The air to the grates is not only heated by passing through the air heater itself, but it also absorbs additional heat during its passage over the boiler casings, both to and from the heater. By this means the boiler casing is used to assist

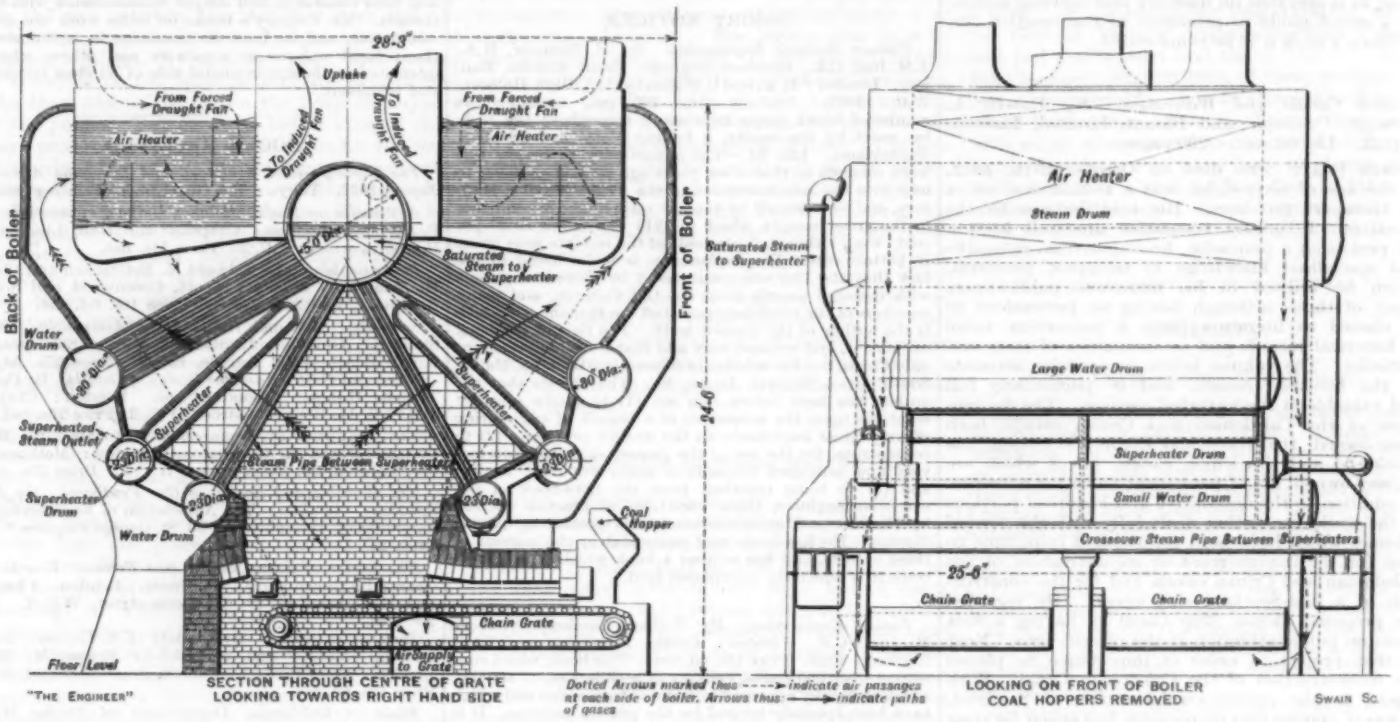


FIG. 1—YARROW WATER-TUBE BOILER AT THE DUNSTON ELECTRIC POWER STATION

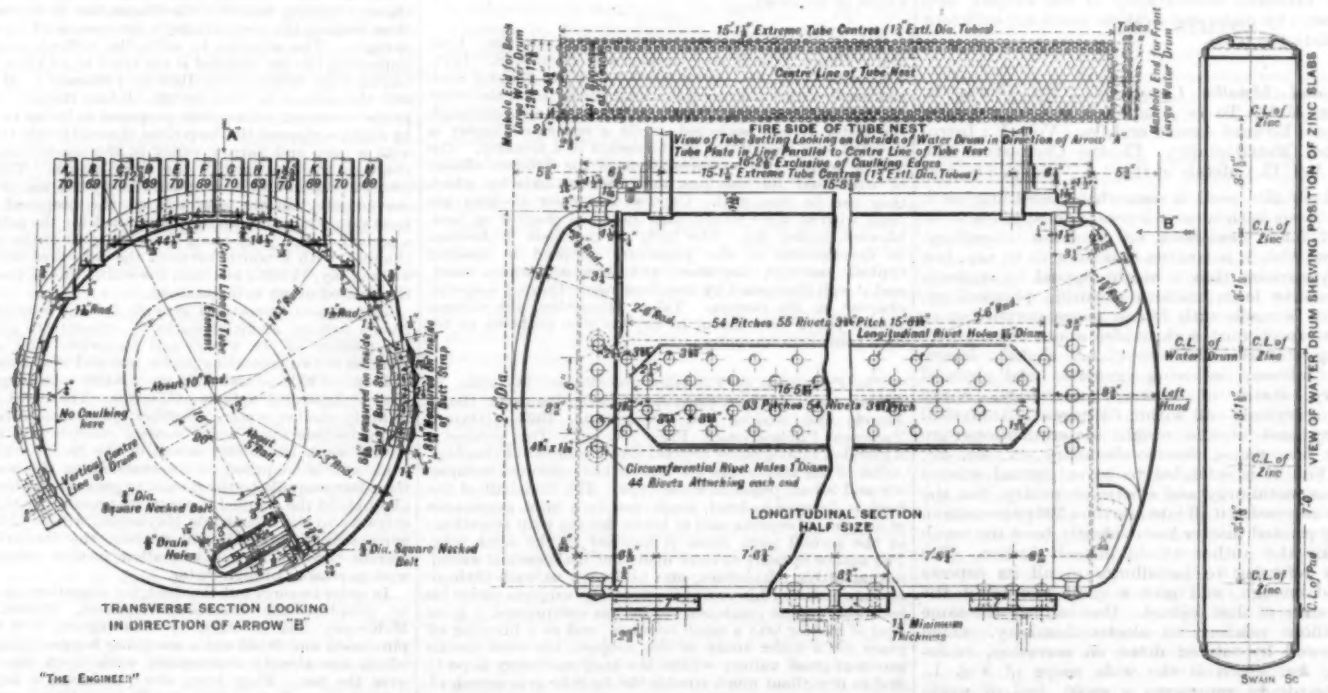

FIRE SIDE OF TUBE NEST
TRANSVERSE SECTION LOOKING IN DIRECTION OF ARROW "B"
LONGITUDINAL SECTION HALF SIZE
VIEW OF WATER DRUM SHEWING POSITION OF ZINC SLABS
"THE ENGINEER"
SWAIN Sc

FIG. 2—THE WATER DRUM OF A TYPICAL YARROW LAND TYPE BOILER

in heating the air and at the same time the radiation losses through the casing are reduced.

TESTS.

The normal output of the boiler is 64,000 lb. of steam from and at 212 deg. Fah. The trials, however, were made from a feed temperature of 80 deg. Fah. to superheated steam of about 720 deg. Fah., which at the working pressure of 215 lb. per square inch corresponds to a degree of superheat of about 330 deg. Fah. This feed-water temperature was used on the trials, and was fixed to meet certain specified conditions, but in general practice it is considerably higher. An output of 64,000 lb. of water evaporated per hour from and at 212 deg. Fah. corresponds to an evaporation of rather more than 7 lb. of water from and at 212 deg. Fah. per hour per square foot of generating surface. At this rate of evaporation, approximately 30 lb. of coal were burned per square foot of grate area per hour. An analysis of coal was obtained in accordance with recognised methods, and an efficiency on the normal load trial of 86 per cent. was obtained, the analysis of the waste gases at normal load showing 12.6 per cent. of CO_2. During the overload trials the output obtained was approximately 90,000 lb. of water evaporated per hour from and at 212 deg. Fah., and it was shown that the limit of output on this trial was determined by the capacity of the forced draught fan, which had not been designed for so high an overload demand; otherwise there was no reason why the boiler should not have been worked up to a greater output.

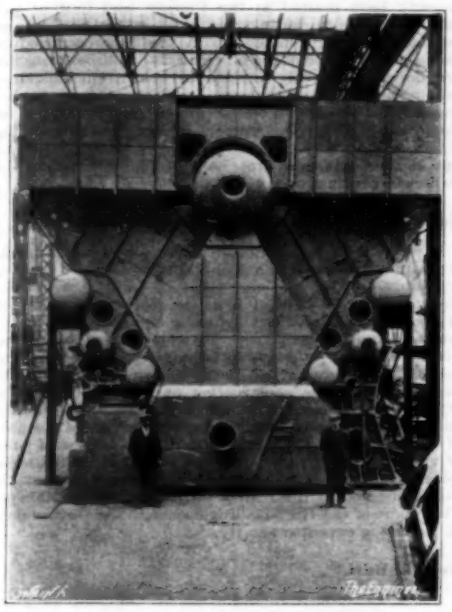


FIG. 3—VIEW OF THE DUNSTON BOILER

Careful records of temperatures were made by means of pyrometers placed between the different rows of generating and superheating tubes in order to show the fall in temperature as the gases passed through the two nests of tubes and through the superheater. In the curves and key plan—Fig. 4—the temperatures at the different rates of evaporation are shown, the position of the pyrometers being indicated by the dotted lines. It is of interest to note the rapid drop in temperature of the gases in the first two or three rows. The curve exhibits a slight rise in the region of the superheater showing that the temperature of the gases was not reduced to quite such an extent when passing over the superheater tubes, but it will be noticed that as soon as they again come into contact with the generating tubes, which were, of course, at a lower temperature, the curve falls more rapidly.

There is one feature in the trials which is particularly interesting, that is, the difference between the draught at the funnel base and that over the grate. At normal load the draught at the funnel base was 0.32in. of water, while a similar reading taken over the grate was 0.25in. This small difference is to be attributed by the large area provided for the passage of the gases from the furnace, through the nests of tubes to the chimney, as well as to the absence of baffles or any other restriction. Possibly the absence of bird-nesting experienced with this boiler is to some degree to be accounted for by the slow velocity of the gases through the tubes.

At normal load the temperature of the flue gases was reduced by about 220 deg. Fah. by the air heater, while the average temperature of the air passing under the grate was about 300 deg. Fah. So far no injurious effects have been experienced on the grates or the brickwork or any other part of the boiler by air temperatures up to 362 deg. Fah, which is the limit reached during the trials, and it would appear that the grates might have been worked at a still higher temperature without harm.

In order to collect additional data, in the first instance the boiler was run under induced draught conditions only, the motor-driven fan being situated above the boiler and drawing air from the back and front of the casings, and delivering it through the air heater down the sides of the boiler casing to the grates. These passages, together with the air heaters, increased the resistance so that the draught over the grate was about 1.5in. of water, with the result that cold air was drawn into the furnace through the coal hoppers. Trials were then conducted under balanced draught conditions, a forced draught fan being introduced into the system. It reduced the draught over the grate at normal load from 1¼in. to about ¼in. to ½in. water gauge as desired. The advantages of balanced draught are well known, and, as was expected, the output and efficiency secured on the trials carried out under these conditions was somewhat higher than when the boiler was working with induced draught only. It was also found that under balanced draught the furnace conditions could be kept more uniform and were more easily controlled.

The result of these trials showed that a high output can be obtained per square foot of heating surface without any falling off in efficiency, this characteristic being largely due to the ample combustion space and the large area of the generating surface, which in a Yarrow boiler is subject to direct radiation. The well-inclined straight tubes also promote rapid circulation.

LAND AND MARINE BOILERS COMPARED.

If the size and output of boiler installations in electric power stations are compared with marine practice for boilers of similar output, it would appear that in many instances the size of boiler adopted for land work is larger than is necessary. It is possible to force a boiler of the Yarrow type to a considerable overload with safety, especially if advantage is taken of all the improvements that have been made in recent years to mechanical grates and forced draught appliances. If, for instance, in a certain power station it is necessary to cope with a peak load of 50 per cent. or more for a short period, it will often be found that the boilers installed to meet this requirement are of such a size that they will be working most of the day very much below their normal rating. Boilers are often designed to provide 25 per cent. overload above their normal capacity, so that in stations in which more than 25 per cent. overload is demanded, even for a very short period, it follows that under normal conditions the boiler is larger than is necessary, and is being worked below its designed capacity.

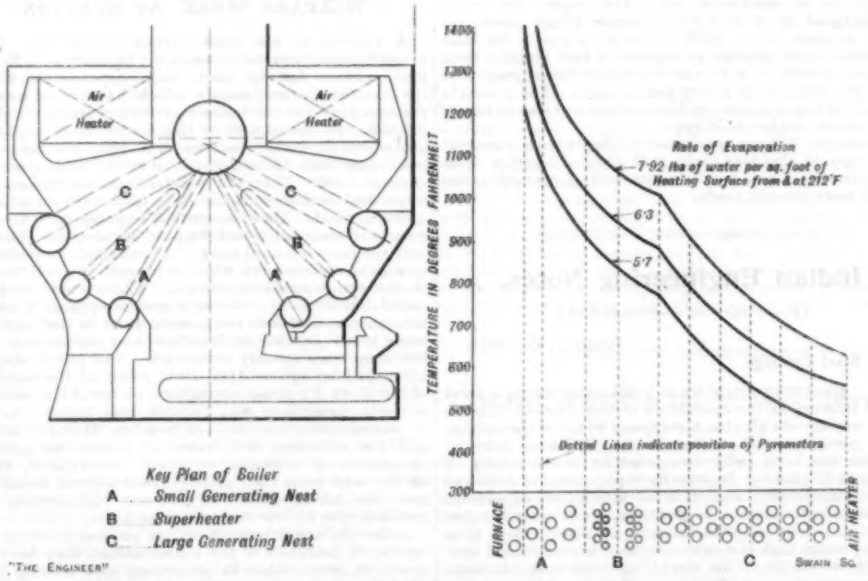


FIG. 4—KEY PLAN OF BOILER AND CURVES SHOWING RATES OF EVAPORATION

Considerable saving in capital outlay is possible in many instances by installing a boiler of such a size that it can work at its normal rating most of the day and yet be found capable of giving an extra output of 50 per cent. or more when it is necessary to deal with peak loads. Not only is there the saving in initial costs and other advantages that a smaller unit possess, but the boiler will be working generally at its normal and designed load, and therefore at its maximum efficiency. The efficiency will, of course, be somewhat less when working at a considerable overload, but as the overload is only carried, in most instances, for a short period the loss is not of great importance.

There are cases in which a very high peak load has to be dealt with, and in such instances oil burning may be adopted with advantage. The very high evaporation which has been obtained with the Yarrow type of oil-fired boiler is of particular service where very large overloads have to be met.

It may be of interest to mention that in torpedo-boat destroyer work a Yarrow boiler evaporates 25 lb. of water from and at 212 deg. Fah. per square foot of heating surface per hour continuously.

SOME OTHER DESIGNS.

The drawing given in Fig. 2 shows the details of a typical water drum for the Yarrow land type of boiler. It will be seen that although the angle at which the outside rows enter the steam drum is considerable, the tube holes are drilled so that the tubes can be kept quite straight. With this design there is no difficulty in expanding and bell-mouthing the tubes, so that they are quite tight, the procedure being in accordance with the usual practice adopted in connection with the manufacture of Yarrow boilers extending over a period of many years.

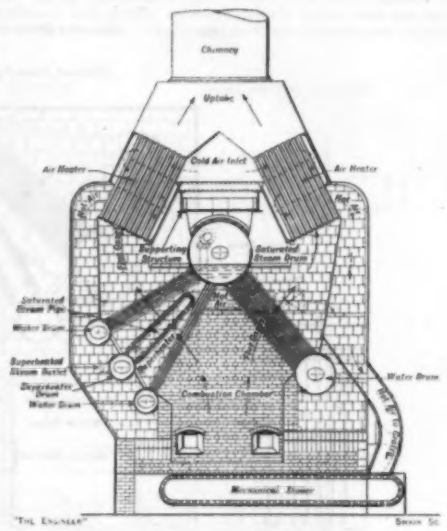


FIG. 5—BOILER WITH SUPERHEATER ON ONE SIDE

A somewhat modified design of boiler is shown by Fig. 5, in which certain improvements based on the experience gained with the boiler at Dunston are introduced. The chief improvements may be briefly summarised as follows:—The superheater is arranged on one side only, so that instead of there being four water drums and two superheater drums as previously described, there are only three water drums and one superheater drum. The air heaters are placed diagonally in the uptakes, which allows of a more compact arrangement, giving a better lead for the gases, and at the same time making it possible for any deposit in the air heater tubes to fall back into the furnace, which, of course, cannot take place where horizontal tubes are used. In the improved design the sides of the boiler—such, for instance, as the brickwork between the drums—are more inclined than in the boiler at Dunston, so as to prevent deposit collecting on the surfaces. The illustration, Fig. 6, shows a similar boiler designed for oil burning or for using pulverised fuel. A series of boilers is now being constructed in accordance with the designs shown in Figs. 5 and 6. At the Brighton Corporation electricity works two boilers of the Yarrow land type of about 40,000 lb. evaporation per hour are shortly to be installed, while a number of boilers of similar design are being made for the County of London Electric Supply Company's new power station at Barking.

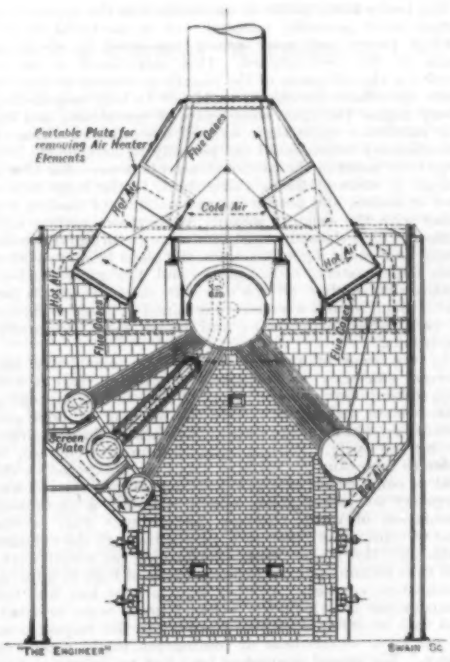


FIG. 6—BOILER ARRANGED FOR OIL OR POWDERED FUEL

We show in Fig. 7 a Yarrow land type boiler of a new and different design from the boilers we have already described. In laying out a boiler-house, it is often con-

venient to place the economiser on the floor level, in which case a top discharge of exhaust gases, such as is shown in Figs. 5 and 6, is hardly the best arrangement, in that the flue must be brought down to the economiser and then taken up to the chimney. In the type of boiler referred to the gases are discharged from one side, and an easy flow to the economiser is thus obtained. A further advantage of this arrangement is that the bulk of the heating surface of the boiler may be arranged on the flue side, and the full benefit of radiation be secured. Four or five rows of tubes are arranged at the front side of the boiler, so that the radiant heat in this direction is also made use of. The various details of construction will be noted from the drawing reproduced in Fig. 7 already referred to.

In conclusion, we may state that the Yarrow boiler at the Dunston power station has now been in operation for a considerable time, and we understand that it has proved to be economical, not only in fuel consumption, but also in maintenance charges, whilst its flexibility has been found to be advantageous in dealing with sudden and rapidly varying loads.

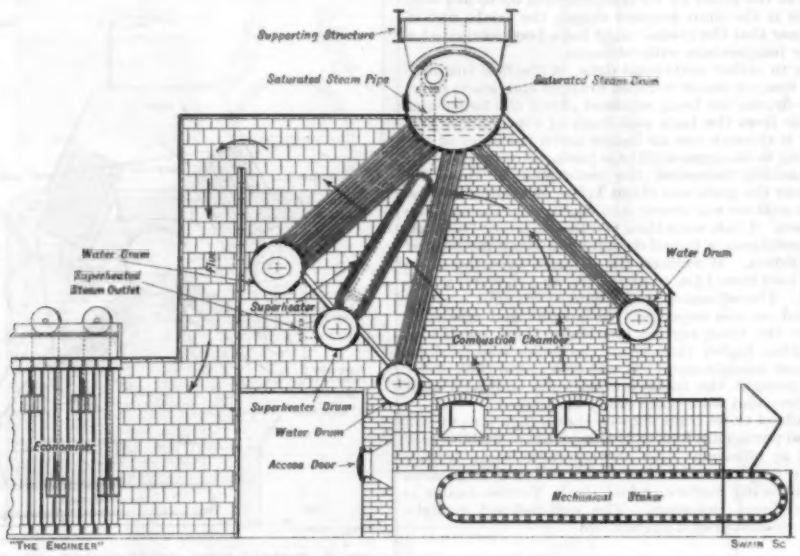


FIG. 7—BOILER ARRANGED WITH DOWN-TAKE TO ECONOMISER

Diesel Engine Users' Association.

AT the June meeting of the Diesel Engine Users' Association on Friday last Engineer-Commander W. P. Sillince, R.N., read a paper on "Losses in Heat Engines and Means of Reducing Them." The author referred to the present insistent and pressing demand amongst users of power for economy. Every avenue leading in this direction was, he said, carefully explored by those responsible for the generation and distribution of power, in order to reduce their working costs and to increase the output of, and the revenue from, their plant.

The brake horse-power of an engine was the measure of output most generally adopted, but in electrical undertakings power was more usually measured as electrical units at the switchboard. This introduced a factor involving the efficiency of the electric generator at various loads, for which the engine could not be held responsible. Every engine ran upon some cycle of operations, and for any particular cycle there existed a maximum value of the efficiency which could not possibly be exceeded. The large heat losses in the case of steam plant were due to the change in state of the working fluid, to the large latent heat of steam, and to the impracticability of feeding the boiler with the exhaust steam. With steam turbine machinery of high-class construction working with high-pressure steam and under a good vacuum, the plant being provided with superheaters, economisers, and the most modern heat-saving appliances, the efficiency might reach 20 per cent. Such results were rarely attained in practice except in very large installations and under most favourable conditions.

In the case of internal combustion machinery the thermal efficiency was considerably greater than it was with steam plants in consequence of the combustion taking place within instead of outside the working cylinder and because no change in the state of the working fluid occurred during the cycle. With internal combustion engines, in order to maintain the surfaces which were exposed to the heat of combustion at a safe working temperature, it was necessary to jacket them and to maintain a continuous circulation of water through the jackets. Part of the heat of combustion, therefore, passed through the cylinder walls into the jacket water, performing no useful work, and thus forming one of the main losses of heat in internal combustion engines. Another serious heat loss was the temperature at which the exhaust gases were rejected, and with no attempt at heat recovery in this respect over 30 per cent. of the heat of combustion might escape to waste. The actual amount of heat lost to jackets and to exhaust, expressed as a percentage of the heat contained in the fuel used, depended upon the type of engine, its cycle, speed and size.

Several successful tubular waste heat boilers having good efficiencies for generating steam under pressure from the exhaust gases of internal combustion engines were now on the market. By means of such boilers from 1½ lb. to 3½ lb. of steam might be generated per hour per brake horse-power of the engine at full load, the amount depending upon the thermal efficiency of the engine, and the percentage of its heat of combustion rejected to the exhaust. It was essential, however, that if the process was to be efficient the exhaust gases should be led into the boiler with as little loss of radiant heat as possible. This meant that the boiler should be placed in the closest possible proximity to the engine—an important point which was, at times, overlooked. The output of a waste heat boiler depended greatly on the load on the engine and the state of the exhaust. Continued operation under light load conditions was not favourable to high efficiency. It should also be borne in mind in connection with the use of exhaust heat boilers that if the fuel contained appreciable quantities of sulphur, the exhaust would contain sulphurous oxides which, in the presence of moisture, would form sulphuric acid. Although cast iron was fairly immune from attack, wrought iron or steel would be subjected to rapid corrosion.

Certain generating stations having a mixed plant of internal-combustion engines and steam engines applied the exhaust from the oil engines to heat the boiler feed-water. This made a simple and inexpensive arrangement and enabled about one-third to one-half of the exhaust heat available at the economiser inlet to be recovered in the economiser. In such arrangements the exhaust gas connections should be as short as possible, as the temperature of the gases falls very rapidly with the length of exhaust pipe used. It might, remarked the author, perhaps not be out of place to mention that what was usually termed "loss to jacket water" frequently included heat which should be debited to the "loss to exhaust," since the jackets received heat not only during combustion and expansion but also during the exhaust stroke.

In the case of the Still engine it was claimed that all the heat usually lost through the jackets was recovered as well as a large percentage of that which passed out with the exhaust. The recovered heat was used to increase the output of the engine and to improve its efficiency without the use of additional fuel. The engine was being manufactured as a four-stroke single piston heavy-oil engine in sizes up to 1000 brake horse-power for land purposes, and for marine propulsion it had already been built and tested as a two-stroke single-piston engine of about 350 brake horse-power per cylinder. The principle was further being applied to locomotives and also to heavy oil engines of the hot-bulb type.

Commander Sillince concluded his paper with a general description of the four-cycle Still engine, together with some particulars concerning its method of operation and data of tests already made.

Indian Engineering Notes.

(From our own Correspondent.)

BOMBAY, May 26th.

Indian Steel Castings.

ENGINEERING circles in India are evincing a great deal of interest in the operations of the Pioneer Electric Steel Company of Calcutta, a company which is specialising in the production of steel castings. Hitherto, industry in India has been sadly hampered by the necessity of sending to England or America for replacement of defective parts of machinery, and it is no uncommon experience for a factory to have to be partially, if not entirely, shut down for several months on end. Consequently, it is not surprising that the new company has attracted considerable attention. The works are very small in comparison with those in other parts of the world, consisting only of two 30 cwt. Stobie electric furnaces, each capable of five melts per twenty-four-hour day, but it is significant that the Government Metallurgical Inspector's tests indicate that the castings produced by the company could, with reasonable certainty, be expected to comply with Grade A of the British Standard Specification No. 30, and with Lloyd's specification. In addition to castings, the company is producing tool steel bars, but no high-speed steel has yet been made.

Successful Hydroglisseurs.

For some time past various public bodies in Northern India have been investigating the possibility of employing "hydroglisseurs" for communication purposes on the broad rivers which are a feature of that part of the country. It will be recalled that these novel craft proved very useful in Mesopotamia during the war, but the results obtained recently in India eclipse all previous records in the East. One particularly notable performance was that of a hydroglisseur, fitted with a 90 horse-power aero engine, which covered 150 miles in six hours on the river Sutlej. This craft has now been taken over by the engineers in charge of the Sukkur barrage scheme, by whom it will be employed as a despatch boat. An announcement is also made that another, and much larger, hydroglisseur, is almost completed. Equipped with a 240 horse-power aero engine, she is expected to carry fifteen persons at a speed of 50 miles per hour.

Aerial Ropeways.

The success of the aerial ropeway through the Khyber Pass has resulted in the resuscitation of several similar schemes which had been held over until the former had proved its worth. Several small installations have recently been erected in the Punjab, and four or five more are likely to be taken in hand in the near future, notably one near Simla, two in the neighbourhood of Darjeeling, and one in the Nilgiri Hills. All these schemes are designed for the carriage of general merchandise, but it may be noted that the aerial ropeway is also becoming increasingly popular in the coalfields, and in this connection the Government of Bengal is introducing a Bill which gives to aerial ropeways a definite status, but at the same time protects the mineral rights of the owners of the land over which the ropeway runs.

New West Coast Harbour.

The Governments of Mysore State and Madras are jointly interested in a proposal to construct a harbour at Mangalore, on the west coast of India, due west of Bangalore and Madras. For several years past the Mysore Durbar has been agitating for an outlet to the sea, and it is believed that the Government of Madras views the latest proposals in no unfavourable light. The scheme, as at present set forth, is that Madras shall be responsible for the construction of the harbour, whilst Mysore will undertake to make the necessary railway connection between Mangalore and Arsikere, a distance of approximately 120 miles. From the commercial point of view it appears to be an attractive scheme, for besides developing the coastwise trade of Mysore it will at the same time benefit the British territory in North Malabar. The report of the Harbour Engineer with the Government of Madras is expected shortly.

News in Brief.

The South Indian Railway Company proposes to connect Trichinopoly and Villupuram, a distance of 100 miles, with a metre gauge line. Villupuram is close to Pondicherri, a French possession, and the proposed new line will give both places a greatly inproved connection with the south and south-west coasts.

Bombay Municipality has adopted a big scheme for improving the roads in the city. Two-coat bitumastic asphalt is to be chiefly employed.

The announcement that the Institution of Mechanical Engineers proposes to hold examinations in India during the present year has attracted considerable attention, and it is expected that a large number of candidates will be forthcoming.

The Banmor (Gwalior) works of the Indian Cement Company have begun production. Additions to the company's works at Porbandar are projected.

WELFARE WORK AT STANTON.

A VISITOR to the blast-furnace and foundry plants of the Stanton Ironworks Company, Limited, near Nottingham, cannot fail to mark with appreciative interest the excellent arrangements which have been made by the company for the welfare of both workmen and staff officials. In the centre of the works an extensive and well-planned works' canteen has been erected, where hot meals may be served for over 500 employees at a nominal cost. Near the main offices an officials' club-house and dining-room has been built with an adjoining sports ground. These amenities, together with the well-equipped ambulance and first-aid service, are, however, only the more outward signs of a broad and comprehensive system of welfare work which is carried on in all branches of the company's undertaking. There were, doubtless, initial difficulties in evolving a system capable of application on practical and commercial lines to coal and iron-stone mines, ironworks, foundries and engineering shops, but they were quickly overcome. The initial step was taken as long ago as April 19th, when, at the suggestion of Mr. E. G. Fox, the managing director of the company, a works committee was brought into being. At each of the company's works—at Stanton, Holwell, Alfreton and the collieries and ironstone mines—an executive committee of workmen of about twenty-four, elected by the men from their general committee of about fifty, meet the management every month, the meeting being presided over by the managing director.

Although these committees in no way interfere with legitimate functions of the trades unions, they have been found of great value in presenting and settling points of difference, and enabling the management to place before the workers matters pertaining to the general well-being and policy of the company. We understand that at the ironworks the works committees have enjoyed the full co-operation of the various trades unions concerned, but that at the two committees formed in connection with the collieries work has been carried on without such assistance. Brief mention may be made of works institutes, and the scheme whereby apprentices are encouraged to attend evening classes, and certain chosen apprentices are allowed to attend technical day lectures at the Nottingham University College. A recent innovation has been the extension of the scheme whereby supplies for the canteens and club-house, and for the domestic requirements of the staff, may be obtained from a retail stores in connection with the Stanton works. By careful buying in wholesale quantities and with small operating costs, it is possible to supply commodities at prices about 20 per cent. lower than the ordinary retail prices.

Magnetic Drum Recorders.

ON Wednesday, April 11th, Dr. McLachlan read a paper before the Wireless Section of the Institution of Electrical Engineers, on "The Application of a Revolving Magnetic Drum to Electric Relays, Syphon Recorders, and Radio Transmitting Keys." The instrument, which was shown in operation, consists of an iron drum with an annular recess containing one or more coils of wire, the ends of which are connected to slip rings. The drum revolves in ball bearings, and its periphery, which is shod with cast iron rings, is machined to run true to within .0001in. A small iron or steel shoe fits over the curvature of the ring, and when a current passes through the coil, the drum is magnetised, thus causing the shoe to be pressed on the ring with considerable force. Hence if the drum is revolved a force is required to cause the shoe to slide relatively to the rings. The magnitude of the tangential pull thus obtained is many times greater than that calculated from the product of pressure due to magnetic attraction by using the formula $B^2 a/8\pi$ and an assumed coefficient of friction of $\mu = \frac{1}{3}$. Experiments have shown, however, that μ is about 0.6. The ratio of the experimental pull to the calculated pull, taking μ at 0.6, depends on the flux density at the shoe contact and may exceed 50. Thus the action of the device appears to depend on some form of cohesive action, incited by magnetism.

When current circulates in the coil, the magnetic attraction between the drum and shoe causes the latter to cling to the drum, and a considerable force is required to cause relative movement between the two surfaces. This force can be utilised to actuate relay contacts; a syphon or other suitable inking apparatus. The same principle has also been applied to the operation of signalling keys, and the scheme has other applications beyond the realm of radio-telegraphy.

The working of the instrument will be readily understood on reference to Fig. 1, which shows in plan and elevation the general arrangement of a recorder. The revolving drum of well-annealed Swedish iron is mounted complete with two coils and corresponding pairs of slip-rings in ball bearings. One end of the shaft is connected to a 15/1 worm-reducing gear, the worm being driven by a variable-speed electric motor of $\frac{1}{20}$ to $\frac{1}{4}$ horse-power, running at a maximum speed of about 3000 revolutions per minute. In order to minimise wear, two cast iron rings are forced over the drum, and they form the rubbing surfaces for the shoe. The latter is made from a ring of Swedish iron, Lowmoor iron or steel, and is fixed to a brass hook by means of a screw. The shoe rides on the revolving cast iron rings, and side play is prevented by a projection on the hook which fits into the annular recess in the drum. One end of the hook is coupled to a weak spring X_2 which serves to hold it in position, and the other end goes to a rocking lever pivoted on the aluminium crank L. On the other side of the rocking lever is a strong spring X_1, which in the absence of signals holds L against the stop S. The tension of X_1 can be adjusted by a milled nut. A pad can be provided to ensure cleanliness of the ring surfaces, but it is not absolutely essential, and in general the apparatus works better without it.

The silver syphon A passes from the inkpot B through lever L, where it is securely held by a locking device, and projects about $\frac{1}{16}$in. beneath its lower face, resting on the paper strip which is pulled from the drawer in the base of the instrument by the paper drive D. When the revolving drum is magnetised by the signal current, the shoe presses on the cast iron rings and is carried round, thus pulling lever L on to stop M, where it is held until the current is interrupted. On cessation of the current, the spring X_1 draws the lever back to the stop S. Thus the transverse motion of the syphon over the moving paper strip produces the record. Owing to the large force and the relatively small inertia of the moving parts, the appearance of the tape, especially above 100 words per minute, is vastly different from that obtained with the usual form of syphon recorder. The arrangement of the drum and slip rings is shown in Fig. 2. The record is made in two forms, which are identical except for the paper drive and front plate. In the case of the first form there is a variable friction gear for altering the speed of the paper, although this can also be done by means of the motor rheostats. The speed of the drum can, therefore, be controlled independently of that of the paper. In the second form there is no friction gear, and the speed of the drum and paper are altered simultaneously. In each case the motor and gears are insulated from the wooden base by felt pads, which serve to lessen the noise. In the form of a relay, the instrument is identical with the recorder, except that there is no paper drive. One of the principal advantages of the device seems to be that it will work with very small currents, and can be used on valve circuits. During the meeting the instrument was used for recording signals transmitted from Paris, and samples of the printed tape where handed round to those present. The highest speed yet attained with a working voltage of 100 is 280 words per minute, but this is not the limit. It has been increased to 320 words per minute by augmenting the battery voltage and decreasing the inductance of the drum by reducing the number of turns—4000 in this test. However, these figures are probably adequate for all practical purposes in radio-telegraphy for some time hence. The present design has been altered from the original, inasmuch as the shoe has been made thicker, and therefore heavier, and the syphon longer. A speed of 200 words per minute can be obtained readily with 100 volts, but higher speeds necessitate higher voltages to ensure a sufficiently rapid rise and fall of current.

If an alternating current is supplied to the recorder, it will operate in such a way that all the alternations appear above the datum line. This is due to the fact that the magnetic pull is independent of the direction of the current. Such an effect may be designated as a form of electro-mechanical rectification. The action is enhanced by using a small polarising current in one of the coils.

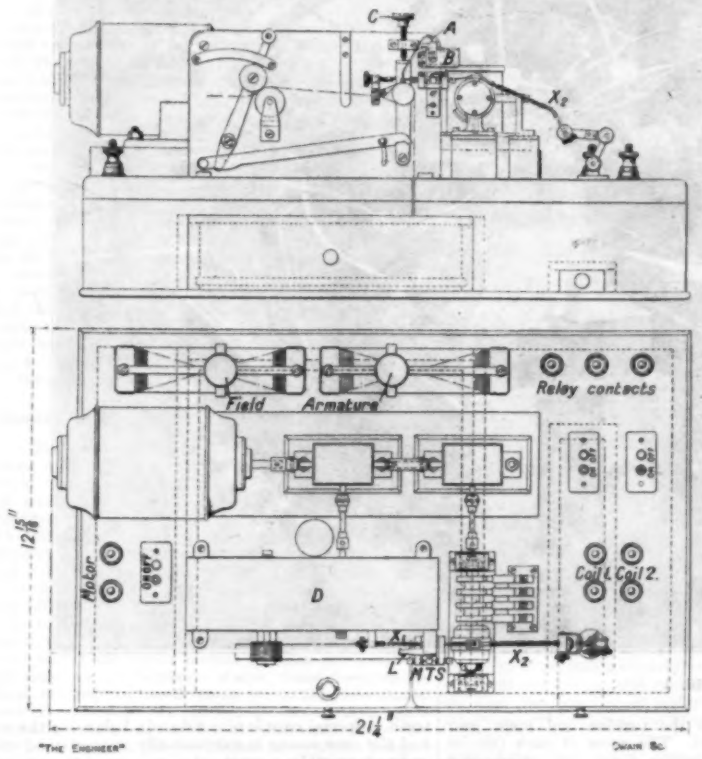


FIG. 1—MAGNETIC DRUM RECORDER

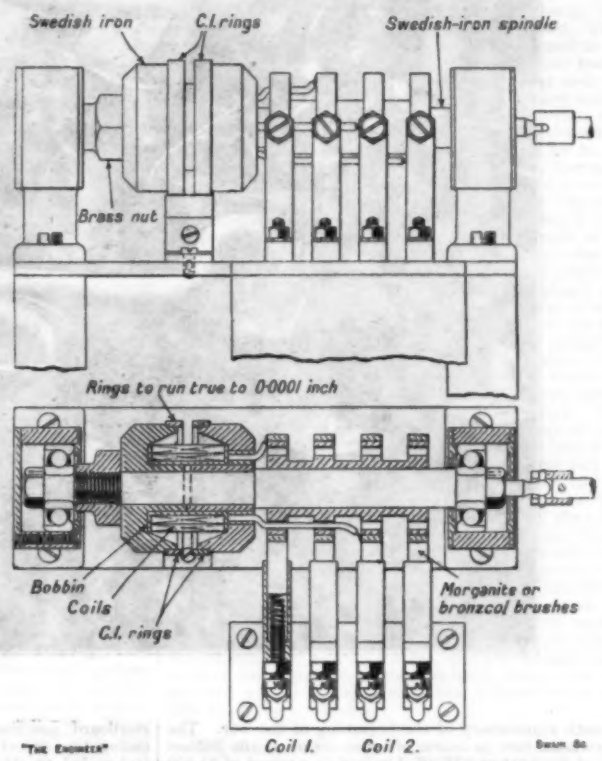


FIG. 2—ARRANGEMENT OF DRUM AND SLIP RINGS

RECENT SCOTTISH OIL DEVELOPMENTS.

THE mineral oil industry originated in Scotland, and the production of petroleum from Scottish shale has continued in spite of the competition of natural petroleum. Indeed, Scottish methods were applied to the production and refining of oil in America. In spite of the keen competition in recent years with natural petroleum and its products, the shale oil industry has continued to prove a profitable undertaking in the hands of well-managed concerns. After the war it was found possible to bring about a unification of the various Scottish oil companies, which enabled the capacity of the existing refineries to be utilised more fully. Under the new arrangement, certain refineries were set apart for dealing with shale oil, and others were then free to deal with the working up of imported crude petroleum. For the past two or three years one of these refineries has been handling nothing but imported crude oil, with excellent results, both as to the quality of products and the scale of operations. With the experience gained on this particular plant, it was resolved to proceed with the erection of a new refinery equipped on thoroughly up-to-date lines to deal only with imported petroleum on a substantial scale. A site at Grangemouth was selected, and an area of about 700 acres adjoining the docks of the Caledonian Railway at that point was purchased. The work was begun by constructing a jetty for the accommodation of tankers bringing in the crude oil and the various ships which carry away the refined products. This jetty has now been completed, along with the necessary pipe lines and pumping plant. An installation of a dozen tanks of considerable size, each having a capacity of about 8000 tons, has now been finished, and some of these tanks are already in use. Other plant comprises a large bench of stills, condensing apparatus, and receiving tanks, and it is understood that these stills, which have been supplied by Henry Balfour and Co., Limited, of Leven, to the designs of Scottish Oils, Limited, will embody the latest heating practice for obtaining a large output. The power plant consists of a steam turbine installation supplied by W. H. Allen and Son, Limited, of Bedford, the steam being generated in a battery of three Thompson water-tube boilers, electric power and light being transmitted to the various parts of the plant. In other parts of the factory the necessary machinery for the chemical treatment and refining of the various products is being erected in commodious buildings. The offices and laboratory attached to the new refinery are now being used, and the scheme includes houses for workmen and staffs, some of which have been occupied for some months. The roads and rail connections between the various parts of the installation are well planned, and when in working order the Grangemouth refinery will form an important addition to British oil refining plants.

A CENTURY OF PROGRESS.

ALTHOUGH the name of the Horseley Bridge and Engineering Company, Limited, is well known in connection with bridge building, it is not generally appreciated that one of its greatest activities over a century ago was shipbuilding. This fact, together with a number of other interesting items in the history of the firm, are set out in a brochure just issued by the company. The first record of the Horseley Company dates back to 1770, but it was not till 1813, when Mr. Manby took control, that the real history of the company may be said to have begun. Some large castings were made in those days, and in the case of one cylinder, cast in 1817, it was possible to drive a wagon and team of horses through its bore. In 1822 the Aaron Manby, the first iron vessel propelled by steam, was constructed at Tipton and put together in London. She subsequently went to France, and was followed by several other successful ships; but the situation of the works was naturally unsatisfactory for shipbuilding, and the business was left to works nearer the coast. The bridge-building trade was, however, actively pursued, and there are iron bridges still in commission which were built by the company as long ago as 1829, a notable example being the Galton bridge at Smethwick. Locomotives were also built at the Tipton works somewhere about 1837, but few details of them have survived. The later activities of the company, in the construction of bridges and structural work in general, gas-holders and steel works plant, are too well known to need detailed reference.

A Large Atlantic Transport Liner.

THE new Atlantic liner Minnewaska, which on August 4th will renew the Atlantic Transport Lines' direct service between London and New York, will, when placed in commission, be the largest steamer sailing from the Port of London. The old "Minne" ships established a high reputation among the travelling public before the war, and they were particularly esteemed for their comfort and steadiness. The service of this line of steamers ceased with the commencement of hostilities, and it is worthy of note that it is to be revived on August 4th,

THE STARBOARD TURBINES OF THE ATLANTIC TRANSPORT LINER, MINNEWASKA

HARLAND AND WOLFF, LTD., BELFAST, ENGINEERS

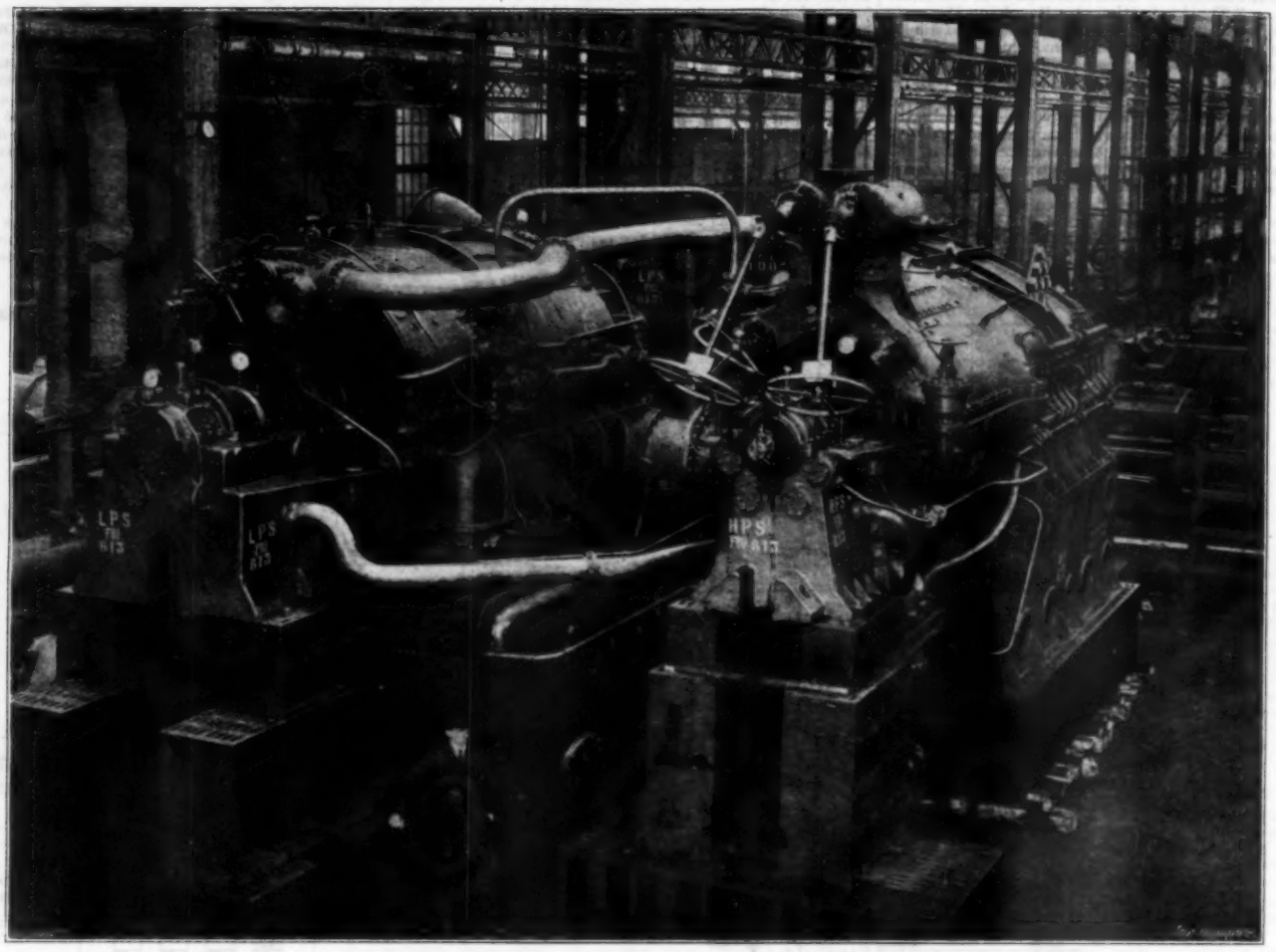


FIG. 1

the ninth anniversary of the beginning of the war. The Minnewaska, now in course of construction at the Belfast yards of Harland and Wolff, Limited, is a vessel of 21,400 tons. She is designed as a one class boat, and will have accommodation for about 370 first-class passengers.

The main propelling machinery consists of two sets of Brown-Curtis single-reduction geared turbines, driving one port and one starboard propeller, and the general arrangement and construction of the starboard set is illustrated in Figs. 1 and 3. Each set comprises one high-pressure turbine, which exhausts into the low-pressure turbine and thence to the condenser, the astern running turbine being incorporated in the low-pressure turbine casing, in accordance with the usual practice. The power developed by each set is about 9000 shaft horse-power, making a total of 18,000 shaft horse-power of the ship. In illustration—Fig. 3—is given a plan view showing the starboard machinery with the turbine and main gear casing top covers removed. The rotor of each turbine is coupled to its corresponding pinion by means of a flexible coupling, and the pinions mesh with large main gear wheels, which are mounted on the propeller driving shafts. In Fig. 2 we reproduce a view of one of the main gear wheels in course of being turned in the lathe preparatory to the cutting of the teeth. The gears are of the double helical type, so as to eliminate end thrust. The teeth are cut in a specially designed machine, and the gears for the Minnewaska are among some of the largest gear wheels recently cut in the builder's shops. It is of interest to note that the operation of cutting the teeth takes about two months to complete, during which time the machine is never stopped. With gears of the type we are considering the size of wheel would appear to be limited only by the life of the cutter which generates the teeth. Special care is also taken in balancing the wheels, and the gear casing is substantially proportioned so that, as far as possible, permanent alignment of the gear wheels and pinions is secured. Fig. 3 also shows the main thrust block of the Michell patented type and the electrically-operated turning gear.

The complete starboard machinery erected on the test bed is shown in Fig. 1, the positions of the high-pressure and low-pressure turbines and the under-hung condenser are clearly shown. On the top of the high-pressure turbine will be seen the ahead and astern control or manœuvring valves, which are operated from a raised control platform.

The auxiliary machinery will be both steam and electrically driven, and will be entirely independent of the main propelling machinery.

Steam will be generated in twelve water-tube boilers

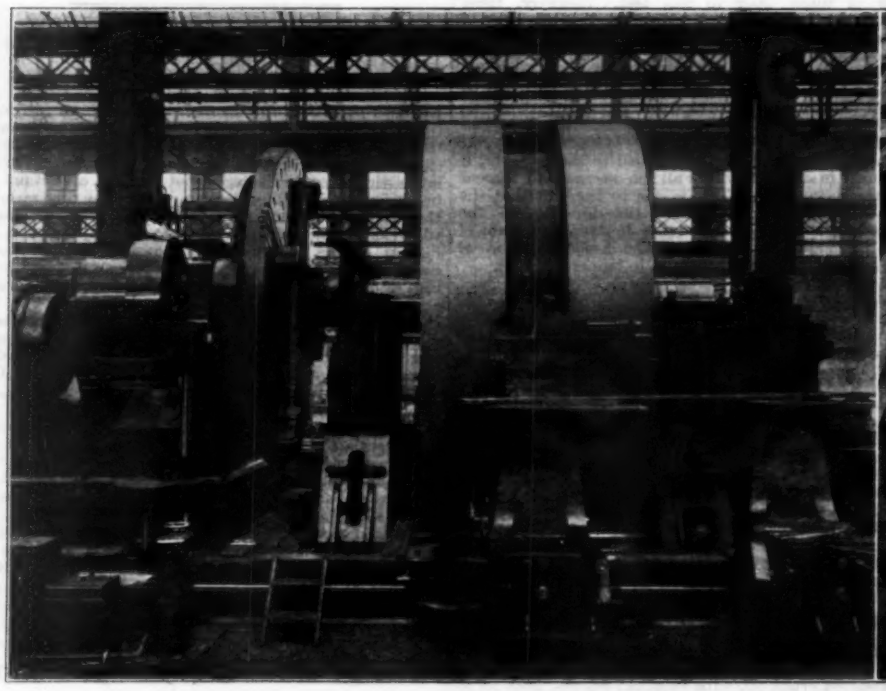


FIG. 2—THE MAIN GEAR WHEEL

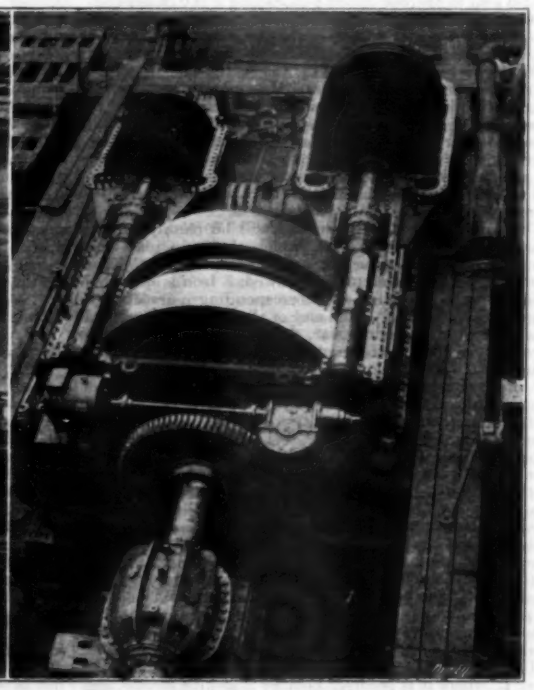


FIG. 3—STARBOARD MACHINERY WITH COVERS REMOVED

arranged for oil burning, working under assisted natural draught, and having a working pressure of 215 lb. per square inch with 100 deg. Fah. superheat.

A sister ship to the Minnewaska, the Minnetonka, is also being built at Belfast, and will most likely be placed in service early next year. The new vessels will berth in the King George V. Dock, the erection of which has greatly enhanced London's facilities for passenger traffic.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Quiet Market.

CONDITIONS in the Midland iron and steel trade show scarcely any change, and business is at a low ebb. The position compares unfavourably with that which obtained when the trade began to emerge from the slump towards the end of last year. The market is again depressed and is badly in need of a tonic. Buyers continue to hold back their orders, only negotiating for sufficient material to cover immediate requirements. Incoming business is not sufficient to maintain industry at the present rate of activity, and producers, especially of iron, talk of closing down blast-furnaces and mills unless they can be sure of a market for their output, for it is now, more than at any time, unprofitable to put material into stock. While production costs have been increased by the additional 7½ per cent. in ironworkers' wages, selling prices are on the decline, producers having had to give way to some extent, though with great reluctance. They have received no appreciable relief in fuel costs. Though inasmuch as there is less stringency in regard to supplies, it would seem that the collieries must soon consider measures for stimulating demand at home, and that can only be done by reduced prices. On the whole, the tone of business is depressed.

Finished Iron Situation.

The Staffordshire iron trade is far from bright, and there is talk of mills coming to a standstill for want of orders. Business is very difficult to obtain, the market having sunk into a half dormant state. Some of the big organisations have still a considerable balance of work on old contracts to occupy them, but new business is not coming in at anything like the current rate of production. Re-rollers are in a difficult position, and there is no confidence in the immediate future. Buyers are holding off for lower prices, but production costs have gone up to such an extent that ironmasters are only making a very meagre profit at to-day's prices. However, in spite of the recent further increase in costs, viz., 7½ per cent. in ironworkers' wages, local ironmasters have been obliged to concede easier prices for some classes of material, especially as reductions have taken place both in Lancashire and in Scotch malleable iron. No change has been effected in marked bars, which remain at £14 10s. There is more disparity in prices of Crown bars, however. The nominal figure remains at £12 10s., but sales have been effected at as low as £12 2s. 6d., while some consumers refuse to pay more than £12. Nut and bolt bars have been reduced to a point where they no longer make a remunerative return. Staffordshire makers are accepting £11 5s., and while Lancashire houses who do business in this district quote £11 7s. 6d., they are stated not to be unwilling to meet buyers on the basis of £11 5s. Belgian shippers continue their efforts to secure the few orders which have been given out by Darlaston nut and bolt manufacturers. This week, again, they have lowered their quotation by 2s. 6d., offering bars at £8 12s. 6d. to £8 15s., delivered in this district. This is at least £2 10s. below local makers' prices. For some time this competition has been more or less ineffective owing to the impossibility of giving deliveries, but now that the railway strike is over materials held up at the works have been released, and early deliveries of supplies are expected. Iron strip can be bought in the neighbourhood of £12 15s.

Reduced Pig Iron Values.

Midland pig irons are cheaper by about half-a-crown this week, smelters having been forced by the persistent pressure of buyers for lower prices to give way a little. Some furnace owners, however, who are well sold, are in no hurry to conform to lower quotations, and at present adhere to the old rates. Forward buying remains at a standstill, and large contracts are practically non-existent. The outlook is not promising for the late summer, and there is talk of some blast-furnaces closing down for want of orders. The coke supply is a little easier and prices are somewhat lower, purchases having been made this week down to 29s. at ovens. Although the concession in fuel prices in the district is less than in the Middlesbrough area, it has assisted in rendering the reduction in pig iron possible, but the main cause is stated to be the unwillingness of smelters to put iron into stock. Sellers of forge iron this week were prepared to accept £4 12s. 6d. to £4 15s. for Northamptonshire iron, and £4 17s. 6d. for Derbyshire. Foundry irons could be bought at North Staffordshire £5 10s.; Northamptonshire, £5 2s. 6d.; Derbyshire, £5 5s. to £5 7s. 6d., all at furnaces. In spite of the several recent falls in the price of northern brands of iron, Midland material is still round about 10s. per ton cheaper.

Falling Steel Prices.

Business in steel is decidedly quiet. The large steel works have for the most part order books sufficiently furnished until July. The railway orders placed a few months ago furnished a very useful series of orders and there is a fair aggregate of constructional work. Under these circumstances these firms are resisting the pressure for easier prices, but others less fortunately placed are obliged to give concessions if they want to sell. Big contracts are being held back until consumers regard prices as stable and small orders are not placed at late rates. While a few makers of small steel bars continue to ask £11, £10 15s. is the more common basis. Some firms, indeed, are stated to be accepting £10 10s. Angles and joists are now down to £10 5s., and tees to £11 5s. Steel gas strip makes £11 15s. This gives a margin of £1 per ton to the tube makers, in steel as compared with iron. The tube works are not quite so busy as they were, and are meeting with increased European competition in the foreign markets. The warehouses have been good customers to the steel works, and as they are disposing of their product freely are expected to come on to the market again shortly. The market for billets has been unsettled by the offers recently received of continental semis at cut prices. Belgian sellers quote £7 10s., delivered in the Black Country, while Midland steel works want £8 10s. upwards. In special exceptional cases this price is stated to have been shaded. There is not much business to be obtained.

Scrap.

A little more is being done in scrap and at slightly better prices. At present, however, the transactions are strictly for urgent needs. Foreign competition is still keen. Native prices are in the neighbourhood of £4 2s. 6d.

Steel Wire.

Some descriptions of mild steel wire have dropped under the pressure of competition, but no general reduction has, up to the time of writing, been declared. The mills are still busy.

Galvanised Sheet Trade.

The galvanised sheet industry continues fairly well supplied with orders, and the local mills are busy. Cheaper billets and spelter keep prices down, and sales are spoken of this week at below the £19 5s. level for 24-gauge corrugateds. Makers of black sheets are also well employed.

South Staffordshire's Flooded Mines.

Much satisfaction is expressed in industrial circles in the Old Hill district that at last a start has been made with the task of clearing the water from the flooded mines in this portion of the South Staffordshire coalfield. The closing of the pits has undoubtedly had some effect on industry in the locality, for many of the works relied solely upon the coal produced in the district, which they regarded as better for their requirements than that of superior quality from other coalfields, besides being much cheaper. Pumping operations have now been started at the Waterfall-lane pumping station, Black Heath, which has been fitted with some of the most powerful machinery of its kind in the country. The capacity of the pump is considerable. It draws up 66 gallons of water per stroke, and makes seven strokes per minute, so that the number of gallons extracted each minute whilst operations are in progress, is 462, or 41 cwt. There are many million gallons of water to be dealt with, and some time must elapse before any material effect will be felt in the area; but it is hoped that the serious problem of coping with the inrush of water has now been solved, and that the mining industry will be able to carry on without more trouble in this direction. It is hoped that the venture will ultimately lead to the unwatering of the whole of the mines in this part of the South Staffordshire coalfield, which at present lie submerged, and so give a new lease of life to the mining industry of this area.

Birmingham Brass Trade.

The Birmingham brassfounders are not being seriously troubled at the moment by German competition, which is too spasmodic and restricted in scope to effect any very serious displacement. As I wrote in this letter last week, the local brassfounders are fairly well employed, and there is a good current of demand. One of the most marked fallings off in German competition has to do with electrical specialities. Not long ago the makers of these goods were being hopelessly undersold, both in the home market and abroad. This competition has gradually faded away. Two or three hundred gross of some particular article may be thrown on the market now and again at prices below the cost of manufacture here, but when they are disposed of they are not followed up by further consignments, at any rate, until some considerable time has elapsed. Birmingham brassfounders, then, are not perturbed so far as the home market is concerned. In the European markets the high rates of exchange are barriers to profitable business.

Black Country Engineering.

Business in the engineering trade in general in the Black Country is only moderate, and many firms normally dependent on the export side for a considerable percentage of their business have been disappointed of late in the volume of business forthcoming. Inquiries there are no lack of, but quotations have to be cut so finely to obtain orders that the result, even when business follows, is often unsatisfactory. There are marked dissimilarities, as one would expect, in an industry like engineering, which touches trade at so many points, but, on the whole, the outlook is not considered any too encouraging.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE depression in the iron and metal markets here continues unabated, and even the iron and steel manufacturers are now beginning to participate in the general gloom, which was before confined to the merchants and consumers. It was, however, fairly clear that if the cloud did not break the manufacturers were bound to feel the depression so soon as they came near the end of the orders on their books. It has been known for a long time that new orders were not being received at anything like the rate necessary to keep the works employed during the second half of the year, and it is now a question whether anything that can be done in the way of reducing prices can be effective in restoring a fair average of sales. If not, there is nothing for it but a sharp reduction of output and perhaps the blowing out of some of the blast-furnaces; although, of course, this drastic and expensive measure will be postponed as long as possible. As was pointed out nearly four months ago, the rise of prices in the iron and steel trades was based very precariously on the stoppage of work in the Ruhr district, and this, although it might cause an advance in prices, could not be other than disastrous to the general economic condition of Europe.

Metals.

There has not been very much change in the position of the non-ferrous metals in this market. Trading remains rather dull, but the prices for copper and its alloys have been fairly steady. No further reduction has been made in the prices for manufactured copper and brass. Strong sheets and rods are quoted at £100 per ton, and flat bottoms at £110. Copper locomotive tubes are at 1s. 2d. per pound and brass tubes at 1s. 0½d. Brazed brass tubes for the home trade are still charged at 1s. 1¾d., while brazed copper tubes are at 1s. 2d., or, to put it in another way, brazed copper tubes are at the same price as solid drawn, but brazed brass tubes are charged at £14 per ton more than solid drawn. The buying in refined copper in this country has been rather better of late. Consumers have been inclined to put out more orders, and one may suppose that they do not now expect much lower prices. It is probably thought that the downward movement which began in March has now gone as far as can be expected, and hence that the chances for a rise are better than those for a fall. On the whole there cannot now be very much danger to the consumer in holding a fairly moderate stock of refined copper, although there is no inducement for him to do other than buy from hand to mouth when he needs manufactured material. There seems to be an expectation of a renewal of buying by the American consumers of copper, based on the theory that they have kept off the market for a long time and must be bare of stock. This movement is expected to give a temporary fillip to the market. The market for tin is still in a very uncertain state, and apparently the market here is waiting for a renewal of the American buying. Our own tin-plate trade has been buying fairly well of late, but the revival of tin prices cannot be expected while America keeps off the market. The outlook is very obscure, and it would be very rash to attempt any forecast. The demand for lead is steady, and the prices keep up fairly well. There is certainly no sign yet of any collapse. Spelter has been a quiet market, and the demand in this country from the galvanising trades is poor; but there does not seem to be any anticipation of lower prices either here or on the Continent.

Pig Iron.

The position in the foundry iron trade cannot be called anything but bad. It is of no use trying to disguise the fact; consumers here either cannot or will not buy foundry iron at the present prices. One fears, indeed, that they cannot, and, if so, it is of no use for sellers to stick to the rates now current. It is clear that some of the Midland furnaces are now beginning to get nervous as to the future, and could make some concession in the price; but consumers want the price back again at the February level, and this would mean a heavy loss to the furnaces if the costs cannot be reduced. The nominal price for Midland No. 3 foundry iron is based on 105s. per ton at the furnaces, but it seems to be believed here that a good order at 100s. would not be refused. This would mean about 108s. to 109s. delivered in Manchester; but the ironfounders here want to buy at the February price, viz., 90s. delivered in Manchester; so it is easy to see what a wide gulf remains between buyers and sellers. There are no doubt willing "bears" of pig iron here, but it is too much to expect them to "bear" at 20s. below the nominal price. Scotch pig iron is again rather easier here at about 127s. 6d. per ton delivered, but no one wants to buy. The purely artificial character of the pig iron market is shown by the fact that Scotch No. 3 on trucks is 5s. cheaper than Cleveland No. 3 on trucks, instead of being 10s. per ton dearer. Hematite iron is again easier and East Coast is on a level with common iron.

Steel.

There is not much change in the condition of the steel market. Business is only on a small scale, but producers find a difficulty in putting down the prices. It is possible that steel plates might be bought a little cheaper; in fact, they are quoted in some places down to £9 15s.; but the nominal price here is £10 5s. and £10 for joists and angles. Both prices might probably be shaded a little.

Scrap.

The market for scrap is very feeble, and prices seem to be still on the downgrade, in spite of the fact that scrap is much cheaper in proportion than anything else. Foundry scrap can be bought here at from £4 to £4 5s. per ton and the best textile scrap at £4 10s. The price at the ironworks for wrought scrap is barely 90s.

Manchester Electricity Undertaking.

The annual report of the Manchester Corporation Electricity Department for the year ended March 31st last states that the sales of current amounted in value to £1,376,518, to which has to be added £18,107, income from other sources. The working expenditure, exclusive of depreciation, amounted to £740,651, leaving a balance of £653,974, from which had to be deducted £525,260 for interest, sinking fund, instalment of loan repaid to Public Works Commissioners and income tax, leaving a net surplus of £128,714, which has been transferred to the reserve fund. On capital account the total outlay of the depart-

ment now reaches £7,211,066, the increase being mainly in respect of the Barton plant. The increase in volume of business amounted to 17 per cent., the annual sales totalling approximately 185¼ million kilowatt-hours. The average price for fuel—taking the stations as a whole—fell by 12s. 4d. per ton during the year. The fuel consumption fell by 0.84 lb. per kilowatt-hour sold. No additions were made to the plant. On the contrary, one 1800-kilowatt turbo-generator, four water-tube boilers, and six Lancashire boilers were removed from Dickinson-street, to make room for additional converting plant and the new 33,000-volt distributing station building. A contract was placed with Bruce Peebles and Co., Limited, for two 2500-kilowatt motor converters. At Stuart-street no additions were made to the plant. There was a very marked reduction in the operating costs, largely as a result of improvements and economies effected in the boiler-houses. The overall thermal efficiency of the station rose to 14.82 per cent. Notwithstanding the stoppage in the engineering industry very fair progress was made with this new station. The efficiency of the distributing system as a whole equalled 84.55 per cent., the quantity absorbed in the mains and distributing stations being 15.45 per cent., showing the slight increase of 0.22 per cent. Against this increase has to be set the fact that the department's consumption of electricity in the generating stations fell from 10.48 to 8.54 per cent.

Institution of British Foundrymen.

For the twentieth annual meeting and conference of the Institution of British Foundrymen, which is being held in Manchester this week, an interesting programme of papers and visits had been arranged. The proceedings opened on Wednesday at the College of Technology, when the new president, Mr. Oliver Stubbs, M.I. Mech. E., gave an address. This was followed by a paper on "Core Irons and Binders," by Professor A. Campion and Mr. J. McEachen. In the afternoon the members paid a visit of inspection to the works of Hans Renold, Limited, at Didsbury, and in the evening the annual dinner was held at the Midland Hotel. Thursday morning was devoted to the reading of papers, one of which was entitled "The Manufacture of Steel Castings and the Preparation of Sand," by Mr. F. A. Melmoth. In the afternoon a char-à-banc trip was made to the works of the Derbyshire Silica Fire-brick Company, Limited, situated between Buxton and Ashbourne. To-day is being devoted to visits to the Manchester Dry Docks and to the Manchester Ship Canal, followed by a trip along the canal to Liverpool. The total number of members on the roll of the Institution is now over 1600, showing an increase of 100 over last year, 616 being full members and 850 associate members.

Electrical Developments on the L.M. and S. Railway.

In welcoming the members of the Institution of Electrical Engineers at a reception and dance given at the Grand Hotel, Llandudno, last week by the London, Midland and Scottish Railway, Sir Edwin Stockton, one of the directors, informed the guests that his company had under consideration a scheme for using at Crewe Works some ten million units per annum produced from the natural water resources, the current being transmitted by high-tension line about 70 miles in length from the North Wales Power Company's generating station. When this is erected it will be the longest transmission line in this country. The railway company has also under consideration the further use of electricity at Holyhead for all purposes in connection with the harbours, works, &c., necessary for dealing with the traffic and mail services between England and Ireland. This will involve about 25 miles of transmission line. The effect of the Crewe and Holyhead schemes will be that less coal will be used by this railway to the extent of several thousand tons per annum.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is not much evidence of life in the hematite iron market at present. Makers are engaged on orders which were placed some time ago, but others are not coming in to take their place. So long as the trouble in Germany continues and so long as the feeling of uncertainty prevails, customers will hold off and will not place any weight of orders. It is known full well that the requirements of consumers are pretty considerable, but they are of the opinion that if the Ruhr trouble is overcome then the disturbing influences will be at an end and the trade will become normal. There is no reduction in the number of furnaces in blast, nor is there likely to be; but if orders continue to fall off there may be some iron which will go into stock. Prices are still inclined to weaken. The shipments of pig iron from Barrow last week were for Liverpool—for trans-shipment—and Glasgow. Ferro-manganese continues to enjoy a fair trade and there is a steady demand for spiegel.

Iron Ore

The iron ore trade continues about the same, with the greater part being used in the district. A certain, but not large, quantity is going out to Scotland and the Midlands. The Cumberland mines are enjoying the greater activity. Foreign ore is in moderate demand, and two cargoes arrived last week from Almeria and Kirkenes respectively.

Steel.

The steel trade is not very brisk and the Workington mills, which were first on rails and then on sleepers, have practically exhausted the orders held. At the Barrow works there is a little better state of things, but the prices of steel consequent upon the recent disturbing influences are keeping some customers out.

SHEFFIELD.

(From our own Correspondent.)

Increased Output of Steel.

THE extent to which the heavy steel trade of Sheffield and district has improved since the depressed times of a year ago is shown by the figures of output. The statistics for April are now available, and show that the production during that month was 108,900 tons, including 40,000 tons of acid, 59,000 tons of basic, and 4000 tons of Bessemer. In April last year the output was just over 51,000 tons altogether, so that it has more than doubled in the twelve months. This year's April figure is 11,000 tons less than that of March, but in considering this the influence of the Easter holidays has to be taken into account. The production of basic steel in Lincolnshire was 47,000 tons in April, as compared with 49,000 tons in March, and only 9700 tons in April of 1922. Whether the improvement will continue or not remains to be seen. There is nothing much to say about the condition of the furnaces in the city and neighbourhood that I have not said in recent letters. They continue busy, but it is chiefly old contracts that they are working off. The steel makers believe that the time is approaching when buyers will be compelled to order further supplies. In this belief, they are maintaining their quotations for acid and hard basic billets. The market, however, is not so strong, and soft material has been bought at £8 15s., or £1 less than was the case a few weeks ago. There is little life in the market for heavy steel scrap.

The Tool Trades.

There is a very good demand for cold rolled strip, but the crucible steel trade is still in a most unsatisfactory condition. There appears to be a rather brighter outlook in the tool trades, which contain good as well as bad spots. For certain classes of tools, the export demand shows a pleasing advance. The increased activity in the coal trade is putting a good deal of work in the way of firms who make colliery equipment, including machinery, wire ropes, wagons and boilers. At the same time, these firms report that the demand is not what it ought to be, and that colliery owners are only buying to meet immediate requirements. The season for buying farm and garden tools, which is now over, has been a pretty good one, large quantities having gone to Ireland and the Colonies. Files and other engineers' tools are selling better than they were a year ago, but the trades have still a lot of leeway to make up before they regain normal activity. There is keen competition for the work, much of which is taken at prices which promise scarcely any profit. A good report comes from Australia as to the growing popularity of Sheffield saws. The American saw led the way until comparatively recently, but the Sheffield article is now rapidly growing in favour. Coming on the top of what I was able to say last week on the subject of saws, this is very satisfactory.

Lower Prices than Pittsburg.

Attention is being more and more concentrated on the development of trade within the Empire. It is recognised that years must elapse before the European markets can fully recover and take a large share of our export products, and the necessity for pushing trade in the Colonies and Dominions is becoming more and more pronounced. The trade is there to be done, and only energy and organisation are required to obtain it. Mr. William Clark, the President of the Chamber of Commerce, has just returned from a tour in which he has visited Australia and Canada, and last week, in welcoming a delegation of members of the Vancouver Board of Trade to Sheffield, he spoke of the great possibilities of trade with British Columbia. A great deal of steel would be required by the manufacturers there, he said, and he went on to make the striking statement that Sheffield could supply steel cheaper to Vancouver than could the makers in Pittsburg. That was due to the advantage of cheap freight, and all that was necessary was for the British manufacturer to go and look for the orders.

Cutlery Rather Better.

Although the cutlery trade is a long way from being busy, conditions in some departments are not quite so depressing as they have been. The stainless table knife section, which for several years enjoyed a remarkable run of prosperity, has fallen off a good deal. At the same time, the total quantity of cutlery of one kind or another produced in the city continues to be on a large scale. It is in scissors and penknives chiefly that signs of improvement are to be noted, although there is still pronounced slackness. Little is being done in razors of the old type. The silver and electro-plate trades are also in an unsatisfactory state. Such orders as come in are largely for immediate requirements, forward buying being on a small scale. Some interesting details have been published as to the cheapness of some of the goods that Sheffield is now putting on the market. For instance, imitation "Apostle" teaspoons, plated and nicely finished, are being sold wholesale at 23s. per gross, and a capital market exists for them. For price and quality, Germany cannot equal a small nickel-handled penknife with a stainless blade and a shackle, the wholesale price of which is only 4d. Sheffield can also turn out solid steel table knives and forks at 6s. the dozen sets, and although cutlery of this kind receives little attention from the British public, there is, in foreign countries, a great demand for it, which Germany assiduously cultivated in the past.

Aid to Scientific Research.

The University of Sheffield has just received one of the finest gifts it has ever had in the shape of a sum of £20,000, for the purpose of founding an undergraduate scholarship and a number of post-graduate scholarships. The donor wishes to remain anonymous during his lifetime. The undergraduate scholarship, which is to be restricted to boys of King Edward VII. School, Sheffield, will be tenable in the Faculty of Pure Science, while the post-graduate scholarships are intended to enable graduates of the University to pursue scientific research in ferrous and non-ferrous metals. It is the latter side of the gift which is of particular interest to those engaged in the Sheffield trades. The city has always been foremost in its investigation of metallurgical problems. It possesses, in the Applied Science Department of the University, the finest institution of its kind in the world. It is only a few weeks since Sir Oliver Lodge formally opened two very fine research laboratories, each the result of a gift of £10,000 by a leading citizen, one of them intended for the mechanical testing of materials, and the other for investigations concerning magnetism, the magnetic properties of materials and allied subjects. This latest donation will enable the University to make a further advance on lines that will contribute materially to the welfare of the city.

Profitable Undertakings.

The Sheffield Corporation tramways and motor omnibuses made a net profit, for the year ending March 31st, of £94,516, and of this sum £13,214 has been granted for rate relief. Formerly, the service contributed more substantial sums towards the rates, but in 1920 and 1921 no grant could be made, and last year the amount was only £6494. At Nottingham, the rates are being helped to the extent of £10,000 by the trams, and £11,500 by the Electricity Department. The Sheffield electricity undertaking has decided to reduce its charges on all units, including traction, which are charged at 2d. per unit or under; the advance of 60 per cent. on the basic rate, which is now in force, is to be brought down to 50 per cent. The charges on all units charged at over 2d. per unit are to remain as at present, namely, 25 per cent. increase on the basic rate. The Chesterfield Corporation has found itself able to reduce its prices to small power consumers, who will, in future, be charged 2d. per unit per quarter for the first 1000 units, instead of 2½d. for the first 500 units. Leeds Corporation has decided to adopt the therm as the standard of measurement for gas, and is applying for an order fixing the maximum price at 1s. 2d. per therm. In Sheffield, the price is 8d. per therm, which is equal to 3s. 4d. per 1000 cubic feet.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE general trade position in the North of England is extremely disappointing, and the outlook far from encouraging. In almost every section there is a perceptible falling off in business. The association of the Ruhr occupation with the present slump is clear and direct, and until order is again restored and Germany is once more at work, British trade and industry seem bound to suffer.

Cleveland Iron Trade.

The long abstention of buyers from the Cleveland pig iron market has created a situation of grave anxiety for the ironmasters. They are reluctant to damp down any of the furnaces now operating, for even with the plant idle there are considerable standing charges to be faced; but, on the other hand, producers cannot afford to go on turning out iron for which there is no call, and that is literally the position at the present time. The demand is totally insufficient to absorb the output of the blast-furnaces, and already stocks are beginning to accumulate. There are still no signs of any return to the normal activity of the market. Consumers are convinced that prices must fall much further yet. It is a view which is not contested. Ironmasters are keenly anxious to get down to such a low level of prices as would permit of a broadening of the basis of demand at home and abroad. But, having cut costs to a minimum in other directions, the ironmasters contend that deflation is now entirely contingent upon a fall in fuel prices. Cheaper fuel is, in fact, the key to the situation, and it does not seem that there will be any cheap fuel again until the Ruhr mines are fully employed once more. There are reports this week of a little more inquiry for iron, both on home and foreign account, but a lot of these inquiries do not materialise. Possibly makers would shade their prices for a good order, for no one believes that present prices can be maintained, but for small orders on the market there is no inducement to cut prices, and quotations are at the same level as last week, viz.:—No. 1, 128s.; No. 3 G.M.B. Cleveland pig iron, 117s. 6d.; No. 4 foundry, 115s., and No. 4 forge, 112s. 6d. per ton.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade hardly presents a bright feature. After faint indications of returning activity a week ago, the trade has relapsed again into a state of gloom. Producers have a fair amount of work on hand, but no new contracts of any volume are being placed, and the outlook is very uncertain. Prices show a weakening tendency, and although the general market quotation for mixed numbers is still 117s. 6d., there is little doubt that for a substantial order that figure would be shaded. No. 1 is quoted at 118s.

Iron-making Materials.

The foreign ore trade shows no sign of activity. Consumers are reported to hold large stocks, and present prices are no inducement to them to place fresh contracts. Best Rubio is on offer at 24s. per ton c.i.f. Tees. As already indicated, the coke market is the dominating factor in the iron trade just now, and with the export demand a little stronger again, the price of coke is inclined to harden. The lull has enabled the ironworks to get small stores of fuel in hand, and complaints of acute shortage are no longer heard, but the price is still 43s. per ton for good medium furnace kinds delivered at the works, a figure which consumers regard as too high.

Manufactured Iron and Steel.

Much quieter conditions also prevail in the manufactured iron and steel trade. The prolongation of the boilermakers' dispute serves to accentuate the gloom, for the shipyards are no longer sending out specifications. Moreover, in other branches of the steel trade there is a conviction that prices must fall, and this tends to keep

buyers off the market. Both at the steel furnaces and the rolling mills production is declining, but still makers refuse to cut prices to any serious extent. Belgian competition in semi-steel is becoming increasingly keen, and a fall in the price of billets would create no surprise.

The Coal Trade.

There is no change of importance in the Northern coal trade, and certainly no improvement in the prompt position, which still remains entirely in the hands of the second-hand holders, and is very weak and disappointing. There are, however, said to be evidences of a prospective improvement in the forward position. But so far as anything tangible and conclusive is concerned, nothing is forthcoming. The inquiry from Germany is stated to be rather fuller, but under present conditions it cannot be expected to result in much actual business, at least until the huge quantities already held in German ports are either absorbed in German industries or otherwise disposed of and out of the way. French and Belgian buying is very slow, while for Norway, Sweden and Denmark little or nothing is being done, beyond constantly feeling the market in the hope of the present slump continuing, and in order to be in a position to take advantage of the situation when the prices have tumbled down further. The Northumberland steam coal section is exceedingly quiet, and in second hands, which at present rule the market, down to about 26s. is quoted for best screened sorts, and as low as 17s. is indicated for smalls. The Durham market is, if anything, a shade steadier for gas and coking for June and July, but business is more or less in abeyance. The collieries are moderately well stemmed for the actual present, and are more or less philosophical as to the forward prospects of the market, which they regard as quite hopeful. The bunker market, however, is flat, with supplies available at cheaper prices for spot. The coke position is said to be improving for foundry makes, owing to a fuller demand from German sources, which is expected to reduce available stocks considerably. Gas coke is nominally steady and unchanged.

Cleveland Miners' Wages.

At the third attempt the Cleveland mineowners and men's representatives have come to an agreement on the new base rates for workers in the ironstone mining industry in Cleveland. This and the question of the new sliding scale were matters which the employers promised to take into consideration when the miners recently accepted the proposal for a longer working day. An agreement has been reached with reference to the base rates for every separate grade of datal labour in and about the mines. The result of the revision is that several grades will receive considerable advances, while the new scale will be of detriment to none. An important point gained by the men's representatives is the fixing of minimum base rates for workers under twenty-one years of age, employed underground and on the surface, with the understanding that, so far as boys are concerned, the rates mentioned are only minimum rates, and that higher rates are to be paid in accordance with ability shown and the nature of work performed. This marks a great step forward for the miners. The question of a new sliding scale is still under consideration, and no doubt will be raised again at a quarterly meeting of owners and miners' representatives, to be held early in July.

SCOTLAND.

(From our own Correspondent.)

Dull Outlook.

THERE has been no real change in the industrial situation during the past week. Business is becoming more and more difficult to transact, and there is little sign of improvement. With the labour trouble at the shipyards still to the fore, all the kindred industries are suffering, and have probably already lost a considerable number of good orders which might have been placed at recent prices. Even should such business still be forthcoming, the prices gained are likely to be considerably lower than they were a month or two ago. Foreign competition is becoming more prominent, and is almost bound to affect future values. As has so often been the case in recent years at this season of the year, we are again faced with a very quiet period until after the annual holidays at least.

Pig Iron Easier.

The export inquiry for pig iron has perhaps been a trifle better of late, but any increase has been more than counterbalanced by the dearth of orders for home delivery. Outputs have been fairly good, but neither makers nor consumers have been anxious to augment stocks at present, and supplies have therefore increased. Prices have weakened somewhat, but nothing beyond the barest necessities are being bought, and these are very limited. A further drop in prices is expected almost immediately.

Cheaper Steel Wanted.

There have been indications that business might be done in steel plates, sectional material, &c., if prices were more in line with consumers' ideas. Makers are loth to grant concessions, even in face of cheaper foreign quotations, while buyers are evidently quite prepared to wait until easier conditions are in force. In the meantime, specifications for plates and sectional material are scarce, and the time is near when difficulty will be experienced in keeping mills employed. Sheet makers are rather better placed than other departments with regard to booked orders, but are not much better off in respect to new business. The thinner gauges have still a comparatively good export demand, but, apart from this, buying is meagre, both for home and export.

Poor Market for Bar Iron.

Bar iron makers have reaped little benefit from the recent reduction in price, and there seems every possibility that a good specification would receive a further concession. The re-rolled steel department has done a good business in strips, but now finds a serious competitor for both strips and bars in the continental producer.

Coal.

Practically all branches of the Scotch coal trade are finding new business a scarce commodity. The rapid drop in prices and the consequent forcing of supplies on the market has caused a lull in buying, and further weakness is anticipated. Foreign buyers are inactive, especially Germany and France, evidently in the expectation of still cheaper prices. Shipments have been comparatively heavy owing to some good bunkering orders and an increase in coastal traffic. Aggregate shipments amounted to 295,121 tons, against 307,610 tons in the preceding week and 286,748 tons in the same week last year. Home demands are easily satisfied. Industrial concerns are taking very small quantities, and municipal requirements are being kept down to the lowest possible limits. House coal has slackened off and has dropped about 1s. 6d. per ton.

Scottish Colliery Deal.

It has been announced that the Fife Coal Company has acquired the pits of the Earl of Rosslyn's Collieries, Limited, which are situated in Fifeshire in the Dysart area. The pits are known as the Randolph, the Francis, and the Lady Blanche, and the combined daily output is two thousand tons. The bulk of the output from the last-named is shipped from Dysart, and from the Randolph and the Francis at Burntisland and Methil.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

SINCE I wrote a week ago the conditions in the steam coal trade have changed very materially for the worse. Business is in a stagnant condition and prices are falling. Dulness scarcely describes the position, which is becoming a very anxious one, more especially for those firms which hold considerable quantities of coals on contract and for which they have to find an outlet. The majority of the collieries are fairly well placed for prompt loading, but their position is becoming weaker, and it looks very much as if before long they will be pressing their contractors to place tonnage at their disposal. For several weeks past exporters have been experiencing difficulty in getting foreign buyers to operate, because the latter hold the view that prices of Welsh coal must come down in face of the fact that values of North Country coals have fallen to a marked extent of late. A certain amount of business has been done, and it is reported that close upon half a million tons of Welsh coals have been sold in Italy for delivery over the second half of the year. There have also been inquiries for locomotive coals for the Australian Government for shipment to Port Adelaide, and two or three steamers of 5000 to 7000 tons have been chartered at a freight rate of 25s. per ton; but apart from these there have been practically no inquiries from abroad. Middlemen have been gradually reducing their prices in the hope of disposing of their contract coals and securing a profit, but their efforts have not met with very much success, and now it is the turn of the collieries to cut down their quotations. Compared with a fortnight or so ago collieries' prices are down somewhere in the region of 5s. per ton, and they have difficulty in attracting buyers even on the reduced basis.

Docks' Working Hours.

The extra working hours under the partial third-shift arrangement came into operation last week, but the returns of shipments showed a considerable falling off as compared with the previous week. The new arrangement has not, therefore, borne the result that was expected, and it is possible that the men are dissatisfied into the bargain. It was feared that the introduction of the new conditions would be found too late, seeing that the abnormal pressure for coals has worn off and the workmen have lost the benefit which would have accrued had they agreed to the change six or twelve months ago.

Cold Storage at Swansea.

The Swansea Harbour Trust Executive agreed at the end of last week to extend the option to the Swansea Cold Storage Company for a parcel of land at the King's Dock as a site for the erection of a cold storage on a large scale, for another month, pending the preparation of a lease. It is understood that Sir Alfred Mond is to be chairman of the company having the project in hand. The name of the company will be the Swansea Cold Stores, Limited, and the plans provide for the erection of an imposing structure of four floors and a basement, the whole undertaking occupying about 600,000 cubic feet.

Cardiff Pipe Line Contract.

The Cardiff Waterworks Committee recently considered tenders for the laying of the Cardiff Corporation Waterworks second pipe line from Cantref to Quaker's Yard, a distance of 20,800 yards. There were thirteen tenders, and it was explained that the work would include the haulage of the pipes, excavations of the ground, and making good any disturbance caused by the work. The tender submitted by Hybart, Broadhead and Co., of London and Reading, at £62,911 5s. 8d., was accepted.

Dock Charges.

A deputation from the traders of the Bristol Channel had an interview with the officials of the Great Western Railway Company last week relative to the question of the reduction of dock charges. Mr. Felix Pole, the general manager of the company, was unable to be present, but the traders' representatives informed the officials that they had reported to the General Committee the result of the negotiations in March, that the Committee had expressed its disappointment at the concessions granted by the railway company, and that it had decided to urge that further concessions should be made. The representatives of the Great Western Company, replying on behalf of the company, intimated that they considered that a settlement had been arrived at at the March meeting, and therefore they were not prepared to re-open the question. It was, however, stated for the company that it would agree to meet the Committee next week for the purpose of enabling the traders to submit their case for a substantial reduction as and from July.

Current Business.

Extremely quiet conditions have been in evidence on the steam coal market during the past week. The inquiry coming forward is meagre in the extreme, and the anxiety of middlemen to dispose of their contract coals has meant a reduction in values. Whereas recently values were on the basis of 40s. to 42s. 6d., it is doubtful whether any colliery is quoting more than 37s. 6d. for best Admiralty large, and it is fairly certain that none is finding it an easy matter to sell even at this figure, except, perhaps, for fairly prompt lots. Best Monmouthshire large coals are worth about 35s., while steam smalls are weaker and rule from 27s. 6d. to 30s. for the superior qualities. Anthracite coals keep very steady, particularly sized descriptions, which are very scarce, while rubbly culm and duff coals are also tight and firm.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

THE conditions in the tin-plate market are quieter. The demand is on a very moderate scale, with values at the minimum of 23s. 1½d. basis I.C. f.o.b., at which figure makers are prepared to book business.

Welsh Anthracite Deal.

The announcement was recently made that Mr. T. P. Cook, in association with Sir Alfred Mond, had purchased control of Cleeves' Western Valleys Anthracite Collieries, Limited. It is now reported that these two gentlemen have extended their interests in the anthracite area, and have acquired the collieries owned by Mr. David Daniel, J.P., at a cost of round about half a million sterling. Mr. Daniel's anthracite collieries are at Gudnos and Ystradgynlais, and he also has a steam coal colliery at Crynant, employment altogether being given to over 2000 miners.

LAUNCHES AND TRIAL TRIPS.

PENDEEN, steamer; built by Irvine's Shipbuilding and Dry Docks Company, Limited, to the order of the R. B. Chellew Steam Navigation Company, Limited; dimensions, 389ft. by 51ft. 3in. by 27ft. 3in.; 7300 tons. Engines, triple-expansion, 26in., 42in. and 70in. by 48in. stroke; constructed by Blair and Co., Limited, Stockton-on-Tees; trial trip, May 28th.

BRITISH YEOMAN, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited; to the order of the British Tanker Company, Limited; dimensions, 440ft. by 57ft. by 33ft. 11in.; 10,200 tons deadweight. Engines, single-screw double-reduction geared turbines, pressure 200 lb.; constructed by the builders; trial trip, May 31st.

KHANDALLA, passenger steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the British India Steam Navigation Company, Limited; dimensions, 440ft. by 55½ft. by 34ft.; 6100 tons deadweight. Engines, two sets of four-crank triple-expansion; constructed by the builders; trial trip, May 31st.

ROOFING MATERIALS.—We have received from D. Anderson and Son, Limited, Park-road Works, Stretford, Manchester, a little case containing samples of Stoniflex roofing felt and Rok dampcourse, together with a piece of wood treated with Sidol preservative and a handy paint palette. The Stoniflex is a smooth-faced bitumen compound and can be doubled back several times without cracking. The Rok material, which has a considerable proportion of fibre in its composition, is also used as a coating for corrugated roofing sheets in the place of galvanising.

THORNYCROFT'S EDUCATIONAL SYSTEM.—We have previously remarked upon the technical classes held at the works of John I. Thornycroft and Co., Limited, for training their engineering pupils, the success of which continues to be proved at the periodical examinations of the Institution of Mechanical Engineers. At the last one held in April the following six students, trained at the Basingstoke works, were successful in passing the graduate examination:—L. C. Andrews, J. Pyle, J. V. Fergusson, H. G. Radley, H. Johnstone, and F. G. Smith. In addition, the following three were successful in passing the examinations for the associate membership:—A. E. Baxter, A. V. Knowles, and A. E. Read. An important feature of the firm's system is that the class training proceeds in conjunction with works experience, so that students receive a thorough all-round training in motor engineering as practised at Basingstoke works.

THE NEWCOMEN SOCIETY.—The summer meeting of the Newcomen Society will take place on the 21st and 22nd inst. Members will assemble at the Institution of Mechanical Engineers, Storey's-gate, at 9.30 a.m. on the first day and drive to Crayford, where the Fabric Printing Works of G. P. and J. Baker, Limited, will be visited. On the afternoon of the same day a brief tour of Chatham Dockyard will be made, and at 6.15 dinner will be taken in the Bull Hotel at Rochester. At eight o'clock Sir Frank Baines will deliver, at the Guildhall, a lecture on "The Preservation of Historic Buildings and Ancient Monuments." On the following day a trip will be made by motor car to Maidstone, where Hayle Mill (hand-made paper) and, if time permits, the Ivy Mill will be inspected. The party will then return to Rochester, a tour of which will be made under the guidance of Mr. Edwin Harris. The trip will conclude at about five o'clock.

Current Prices for Metals and Fuels.

IRON ORE.

N.W COAST—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	6 3 9	—
No. 1 Foundry	5 18 9	—
No. 3 Foundry	5 13 9	—
N.E. COAST—		
Hematite Mixed Nos.	5 17 6	5 17 6
No. 1	5 18 0	5 18 0
Cleveland—		
No. 1	6 8 0	6 8 0
Silicious Iron	6 8 0	6 8 0
No. 3 G.M.B.	5 17 6	5 17 6
No. 4 Foundry	5 15 0	5 15 0
No. 4 Forge	5 12 6	5 12 6
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge *	—	—
,, ,, Foundry	5 7 6 to 5 10 0	
(3) Northampton—		
Foundry No. 3	5 2 6	—
,, Forge	4 12 6 to 4 15 0	—
(3) Derbyshire—		
No. 3 Foundry	5 5 0	
Forge	4 17 6	—
(3) Lincolnshire—		
Basic	6 0 0 to 6 10 0	
Foundry	5 10 0	—
Forge	5 5 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	15 10 0	—
MIDLANDS—		
Crown Bars	12 2 6 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 5 0 to 11 7 6	
Gas Tube Strip	13 0 0	—

STEEL.

	(6) Home £ s. d	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 0 0	—
Ship Plates ½in. and up	10 5	-
Sections	10 0 0	—
Steel Sheets ¼in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 0 0	—
Joists	10 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 15 0	—
Soft Billets	10 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	12 0 0	—
Billets	11 0 0	—
MANCHESTER—		
Bars (Round)	11 10 0 to 11 15 0	
,, (others)	10 5 0 to 10 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 7 6 to 10 15 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 15 0	—
Intermediate Basic	10 10 0	—
Soft Basic	8 15 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0	—
MIDLANDS—		
Small Rolled Bars	10 15 0 to 11 0 0	
Billets and Sheet-bars	8 10 0 to 8 15 0	
Gas Tube Strip	11 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 5 0 to 19 10 0	
Angles	10 5 0	—
Joists	10 5 0	—
Tees	11 5 0	—
Bridge and Tank Plates	10 15 0 to 11 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/1½ to 23/4½
Block Tin (cash)	197 0 0
,, (three months)	197 7 6
Copper (cash)	67 17 6
,, (three months)	68 7 6
Spanish Lead (cash)	26 0 0
,, (three months)	25 2 6
Spelter (cash)	30 7 6
,, (three months)	30 12 6
MANCHESTER—	
Copper, Best Selected Ingots	72 0 0
,, Electrolytic	75 0 0
,, Strong Sheets	100 0 0
,, Loco Tubes	0 1 2
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 2½
Lead, English	27 10 0
,, Foreign	26 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£50 0 0	18/-
,, ,, 1 p.c. ,,	£60 0 0	21/-
,, ,, 0·75 p.c. carbon	£70 0 0	22/6
,, carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 0 0 scale 6/- per unit	
,, Vanadium	16/9 per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	22/-
,, ,, Ell	22/9
,, ,, Splint	23/6 to 25/-
,, ,, Trebles	23/-
,, ,, Doubles	22/-
,, ,, Singles	21/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	22/-
,, ,, Splint	23.6
,, ,, Trebles	23/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	21/6 to 25/6
Screened Navigation	31/-
Trebles	24/-
Doubles	22.6
Singles	21/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	24/6
Secondary Steam	22/-
Trebles	25/-
Doubles	23/-
Singles	22/-
ENGLAND.	
(8) N.W. COAST—	
Steams	31/6
Household	48/8 to 57/6
Coke	48/-
NORTHUMBERLAND—	
Best Steams	27/- to 28/-
Second Steams	25/- to 26/-
Steam Smalls	17/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	31/- to 32/6
Second	30/- to 31/-
Household	25/- to 28/-
Foundry Coke	60/- to 65/-
SHEFFIELD—	**INLAND.**
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/6 to 30/- —
Derbyshire Best Brights	25/6 to 27/6 —
,, ,, House	23/- to 24/6 —
,, ,, Large Nuts	20/6 to 22/6 —
,, ,, Small ,,	18/- to 21/- —
Yorkshire Hards	22/- to 24/- —
Derbyshire ,,	21/- to 24/- —
Rough Slacks	12/- to 14/- —
Nutty ,,	10/6 to 12/6 —
Smalls	7/- to 9/- —
Blast Furnace Coke (Inland)	32/- to 34/-
,, ,, ,, (Export) f.o.b.	39/- to 40/-
CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	37/- to 38/-
Second ,, ,,	35/- to 37/-
Best Dry Large	37/- to 37/6
Ordinary Dry Large	35/- to 36/-
Best Black Vein Large	35/- to 36/-
Western Valley ,,	34/6 to 35/-
Best Eastern Valley Large	34/6 to 35/-
Ordinary ,, ,,	32,6 to 33,6
Best Steam Smalls	27,6 to 30/-
Ordinary ,,	26/- to 27/-
Washed Nuts	35/- to 37/6
No. 3 Rhondda Large	37/- to 38/-
,, ,, Smalls	29/- to 31/-
No. 2 ,, Large	30/- to 32/-
,, ,, Through	27/6 to 29/-
,, ,, Smalls	24/- to 26/-
Coke (export)	60/- to 65/-
Patent Fuel	38/- to 40/-
Pitwood (ex ship)	31/- to 32/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	50/- to 52/6
Seconds	40/- to 45/-
Red Vein	32/6 to 35/-
Machine-made Cobbles	62/6 to 65/-
Nuts	55/- to 60/-
Beans	45/- to 47/6
Peas	25/- to 26/-
Breaker Duff	12,6 to 13/-
Rubbly Culm	18/- to 19/-
Steam Coals:	
Large	26/- to 27/6
Seconds	25/- to 26/-
Smalls	18/- to 22/-
Cargo Through	22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal.

French Engineering Notes.

(From our Correspondent in Paris.)

Reconstruction.

For a long while past builders and contractors engaged upon reconstruction work in the devastated regions have been complaining of the situation in which they are placed by the Government suspending payments on account of reparations. So far as industrial reconstruction is concerned, the work has been proceeded with, and in many cases completed, with the aid of loans subscribed by the public for a particular group of industries and guaranteed by the State. Thus the collieries, engineering works, sugar factories and other enterprises are more or less nearing their pre-war capacity, and are in some cases surpassing their previous production through the laying down of modern plants; but in the case of private firms and owners who have to depend upon "war damages," the situation has been rendered very difficult by the fact that the State is no longer able to redeem the certificates issued to those entitled to damages, and the paper can only be negotiated for the moment with speculators, who take a very high percentage for commission. Contractors will naturally not carry out work with no other guarantee than this temporarily depreciated paper, and at a Congress held in Paris last week it was announced that unless the Government paid up arrears and gave an undertaking to provide funds for carrying on the work, all further operations in the devastated regions would be suspended.

Industrial Organisation.

The considerable progress that has been made in many branches of industry during the past few years is due, in a large measure, to the thorough system of organisation adopted, whereby each branch is represented by a "syndicate" or association, and all the associations of one group of industries are formed into a union. While each syndicate looks after the interests of its members and deals with all questions affecting the industry, the union occupies itself mainly with the general industrial development. In the annual report of the Union of Syndicates of the Electrical Engineering Industries, for example, figures are given showing that whereas in 1920 the imports of electrical machinery exceeded the exports by 22 million francs, there was, in the following year, an increase of 48 million francs in exports over imports, while in 1922 the difference was 93 million francs. The union has carried out a great deal of useful propaganda work in the way of encouraging the use of electricity for traction, heating, farm work and for domestic purposes, and it has no fewer than twenty-four commissions, each dealing specially with technical problems relating to the electrical engineering industry. A vast amount of valuable work was done by these commissions during the past year. The union is also organising the second session of the International Conference on the distribution of electrical energy at very high potentials. It will be held in Paris in October next.

Railway Centenary.

The celebration last week of the centenary of sanctioning of the first railway constructed in France has reference, of course, to a line upon which wagons were drawn by horses. As it marks the first date in railway history a number of representatives of Parliament, engineering associations and railways went to the little town of Andrézieux, on the Loire, to fix a commemorative plate on the spot where the first station was built. The history really dates from 1814, when M. Moisson-Desroches presented to Napoleon a plan for constructing seven railways throughout the country similar to those which were already in operation in some of the colliery districts in England, the idea being that the railways would "shorten distances" and allow of a much more rapid and economical means of transport. The proposal did not appeal to Napoleon, and nothing further was done until 1821, when a number of engineers and colliery proprietors sought permission from the Government to construct at their own cost "an inclined railway from the Loire to the Pont de l'Ane on the river Furens, through the colliery district of Saint-Etienne." A preliminary inquiry showed that the scheme was strongly opposed by the canal interests, carriers and landed proprietors, to the extent that the officials who undertook the inquiry met with a very disagreeable reception. Nevertheless, a decree was issued by Louis XVIII., dated February 26th, 1823, granting the concession on the ground that "commerce and industry would derive great advantages from the installation, especially for the transport of coal which is produced in abundance in the country traversed." The work began in 1825 on the line from Pont de l'Ane to Andrézieux, where the coal was loaded on to boats on the Loire. The Pont de l'Ane station still exists at the end of the Terrenoire tunnel. The line was completed in 1828, and in April of that year the first wagons started running. Apparently the loads were hauled on a slight down grade from Saint-Etienne to the Loire, three wagons being drawn by one horse. On April 30th, 1843, the company owning the line voted a sum of 300,000 francs for the purchase of two locomotives. For a long time, however, the bulk of the traffic continued to be effected with animal traction, there being four sections of 4000 m. to 5000 m., and the cost was stated to be four centimes per ton-kilometre. Under these circumstances there was evidently no inducement to continue experiments with steam locomotives. The line at least had the distinction of being the first upon which steam locomotives were run in France, and it certainly suggested the construction of the line from Saint-Etienne to Lyons, which really marked the beginning of railway history in the country, the honour, however, being shared with the railway between Paris and Saint-Germain.

Academy of Science.

At the last meeting of the Academy of Science Sir Robert Hadfield was elected "foreign correspondent" in the chemical section. There is usually only one foreign correspondent in each department of the Academy, and the honour is conferred on the scientist having the greatest claim to distinction in his particular line of research, the choice of Sir Robert Hadfield being, of course, due to the valuable work he has accomplished in the chemistry of metallurgy.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

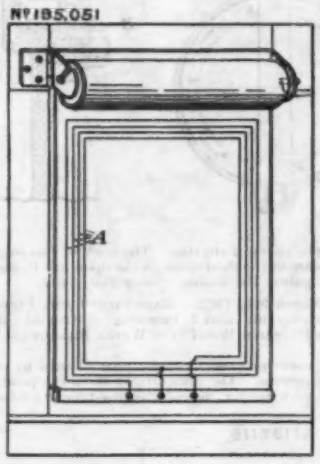
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

195,051. March 14th, 1922.—IMPROVEMENTS IN LOOP ANTENNÆ, *Marconi's Wireless Telegraph Company, Limited, of Marconi House, Strand, W.C. 2.*

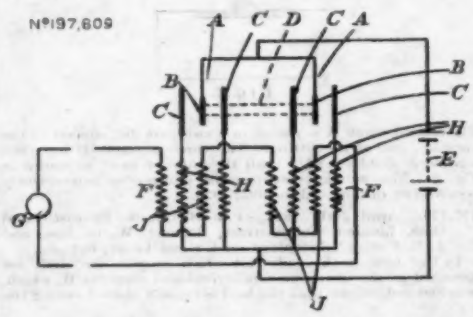
The turn or turns of wire A comprising the loop antenna are attached to a flexible sheet of material so that it may be rolled up in a convenient compact form. A loop antenna is directional and receives best when normal to the wave front of the waves



to be received. To facilitate adjustment a support is provided at one end of the roll and is provided with a swivel or pivot so that the antenna may be rotated about a vertical axis. The structure is mounted somewhat like a window blind and operated in a similar manner.—*May 10th*, 1923.

197,609. May 5th, 1922.—ELECTRICAL TRANSMISSION OF SOUND, S. G. Brown, Victoria-road, Willesden-lane, North Acton.

This invention is concerned with the reproduction of sound, in loud tones, by means of differential microphones, and is said to be free from disturbances. A A are the two microphones, having central plates B and side plates C. D is a connecting-rod, which ensures the two central plates vibrating in synchronism and with equal amplitudes. E is the battery. F F are the two transformers corresponding to the two microphones A. G is the telephone receiver, or relay, circuit. The centre plates B of the differential microphones A are connected to one pole of the battery E, while all the side plates C are connected up in parallel to the other pole through the primaries H of the

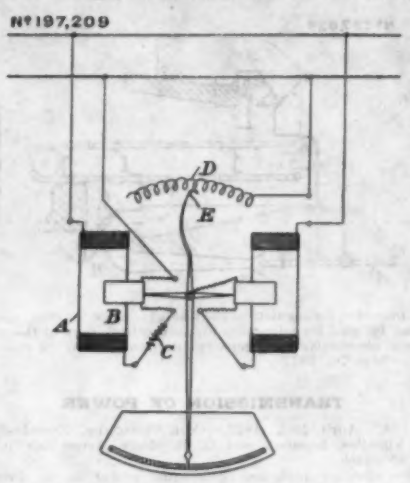


transformers, the secondary coils J of the transformers being connected in series to the telephone receiver or relay circuit G. The secondary coils J of the transformers are connected up alternately in opposition so as to compensate for any current changes which may be in the same direction in the primary coils H, current changes caused by the differential microphones A being in opposite directions in the two coils H connected to the opposite plates C. The centre plates B of the microphones may be connected to the middle of a split battery, to the poles of which the side plates C are connected, instead of connecting the microphones in the manner shown in the diagram, the compensating method being the same in both cases, the transformer coils being connected up in pairs in such a manner that electrical disturbances in the local circuit other than those from the differential microphones act in opposite senses at the transformer, and therefore do not affect the circuit.—*May 17th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

197,200. May 26th, 1922.—IMPROVEMENTS IN ELECTRICAL FREQUENCY METERS, *Lovell Newton Reddie, of 1, Furnival-street, Holborn, E.C. 4.*

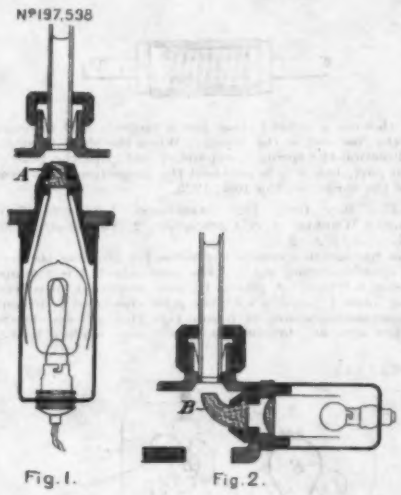
The instrument consists of a fixed coil A, a movable coil B, and a series ohmic resistance C. On the opposite side of the instrument there are similar coils and a variable inductance resistance D, the number of turns in operation being governed by the position of the contact E. The electrical connections are self-explanatory. The directions of the couples of the two electrodynamic systems are opposite to one another, and for a given tension or frequency the pointer takes up the position shown. If the tension increases or diminishes while the frequency remains constant the currents and the couples in the two systems increase or diminish correspondingly, but the moving part still remains in a state of equilibrium and the index finger does not move.



If, on the other hand, the frequency changes, the indicating finger is displaced.—*May 10th*, 1923.

197,538. May 11th, 1922.—ILLUMINATING GAUGE GLASSES, R. Trist and Co., Limited, 12, Clipstone-street, London, W. 1, and M. Bernon, 14, Kensington Park-road, London, W. 11.

The inventors' purpose is to illuminate gauge glasses in such a manner that the meniscus of the liquid in the glass alone shows any light. Beneath the gauge glass and directly in line with it, there is arranged a little window A, Fig. 1, which is illuminated

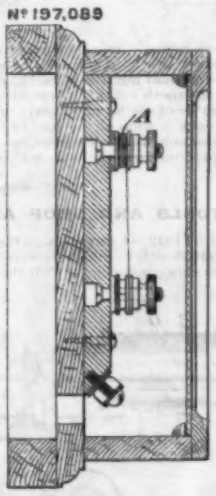


by the electric light shown. The light is projected up the gauge glass, but does not show at the sides, as it is totally reflected inwards. On emerging from the surface of the liquid, however, the curvature of the meniscus deflects the beams of light and the surface appears brilliantly illuminated. Fig. 2 shows the lamp arranged at one side, while the window has a curved projection B to reflect the light upwards. Several other modifications are shown.—*May 17th*, 1923.

LIGHTING AND HEATING.

197,089. February 23rd, 1922.—IMPROVEMENTS IN OR RELATING TO FUSES FOR USE IN ELECTRIC WIRING SYSTEMS, Frederick Charles Bonham Chase, of 195, Archway-road, Highgate, N. 6.

This invention will readily be understood from the accompanying drawing, where it will be seen that metal bobbins A



containing fuse wire are clamped under the upper terminals of a fuse board so that when a fuse blows it can readily be renewed with wire of the correct size.—*May 10th*, 1923.

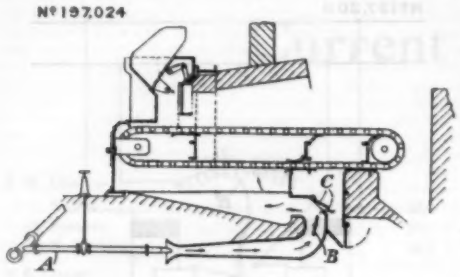
FURNACES.

197,024. February 7th, 1922.—FORCED DRAUGHT FURNACES, A. W. Bennis, Little Hulton, Bolton.

Instead of using a steam jet for inducing a supply of air under

the grate, the inventor uses a high-pressure air supply A. The jet of high-pressure air entrains a large volume of low-pressure air which is delivered to the chamber below the grate. A damper

No 197,024



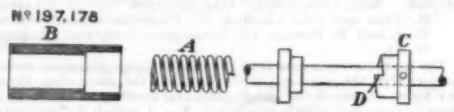
B is provided for regulating the draught, while another, marked C, can be used for admitting air to the back part of the grate. Several alternative arrangements are described in the specification.—*May 7th*, 1923.

TRANSMISSION OF POWER.

197,178. April 25th, 1922.—COIL CLUTCHES, Eversbed and Vignoles, Limited, and G. B. Rolfe, Acton-lane Works, Chiswick.

This clutch is intended to transmit power in one direction only. It takes the form of a coiled spring A that is forced into the bore of the driven member B. One end of the bore is slightly smaller than the spring, so that it is gripped tightly. On the

No 197,178



shaft there is a collar C that has a projection D for engaging with the free end of the spring. When the shaft is rotated in one direction the spring is expanded and grips the bore of the driven part, but if it is reversed the projection rides over the end of the spring.—*May 10th*, 1923.

197,537. May 10th, 1922.—GRINDING INVOLUTE TOOTHED GEAR WHEELS, *A. S. Cackemaille*, 2, *Norfolk-street, Strand, London, W.C.* 2.

This specification covers a process for grinding the teeth of large speed-reducing gears. The gear wheel A is mounted on rollers in a frame. A pinion B, also supported on rollers in a sliding frame C, meshes with the gear wheel and is driven from any convenient source of power D. The two wheels are run together with an abrasive, such as emery, while a brake E is

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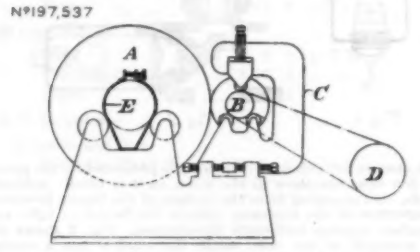
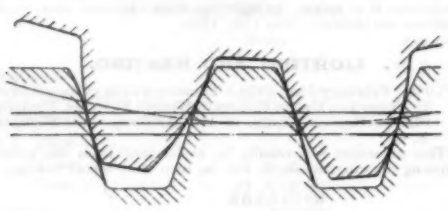




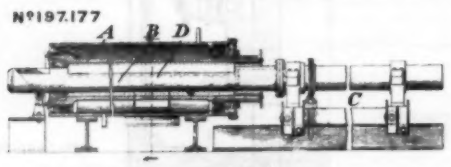
applied to the gear wheel. In the process of grinding three pinions are used successively. They are all cut from a standard blank, one has the normal number of teeth, one has one tooth less, and the last one tooth extra. Alternatively, all three may have the same number of teeth, but slightly different diameters. It is claimed that each portion of the gear teeth will be actually cut by the abrasive at one of the operations, resulting in a smooth, true surface approximating the desired involute curve.—*May 17th*, 1923.

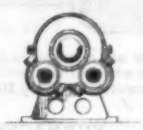
MACHINE TOOLS AND SHOP APPLIANCES.

197,177. April 25th, 1922.—CENTRIFUGAL CASTING MACHINES, W. E. Clow, 534, South Franklin-street, Chicago, Illinois.

This invention is concerned chiefly with the pouring spout of

No 197,177





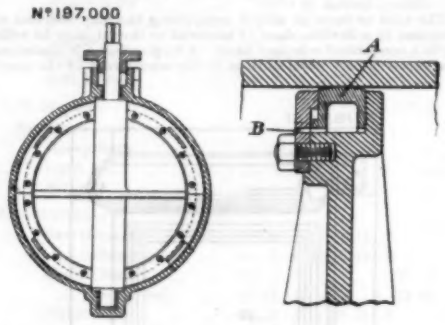
machines used for centrifugally casting pipes. A is the rotary mould and B the pouring spout. The spout is mounted on a carriage C, so that it may be inserted in the mould as shown. The end of the spout protrudes beyond the mould to permit the molten metal being poured in. One edge of the spout or trough is serrated as shown at D, and over this edge the metal is poured, by rotating the spout, at an acute angle to the surface of the mould. The discharge spouts through which the molten metal flows from the trough into the mould are longitudinally separated so that the metal flows into the mould and on to its surface in separate streams. Air and gas are permitted freely to escape inwardly from the mould surface between the inflowing separated streams of metal, so that before the adjacent streams of metal have united the metal has displaced all air and gas. The trapping of air and gas between the metal and mould surface is wholly prevented and the resulting pipe will be devoid of pockets, blow-holes and other imperfections.—*May 10th*, 1923.

MISCELLANEOUS.

197,000. February 2nd, 1922.—BUTTERFLY VALVES, J. B. Broadhead and T. Wood, Woodhouse Works, Brighouse, Yorkshire.

In order to make a good joint between a butterfly valve and its casing the inventors arrange a "contact" ring A in a groove

No 197,000



round the periphery of the disc. The back of this ring is subject to the pressure of the fluid through the openings B, and it is thus expanded against the casing.—*May 2nd*, 1923.

197,119. March 9th, 1922.—MANUFACTURE OF PIPE FITTINGS, J. Howard, jun., and I. Downing, of Stewarts and Lloyds, Limited, Coombs Wood Tube Works, Halesowen, Worcestershire.

The inventors propose to make pipe fittings by a punching or pressing process. The illustrations show the production of a T only, but very similar processes are used for elbows and crosses.

No 197,119

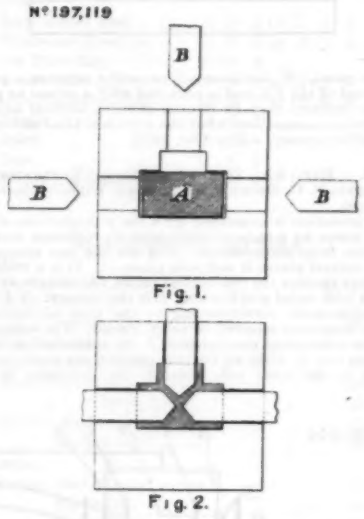


Fig. 1.

Fig. 2.

The heated blank A is placed in a two-part die, shaped to the outside form of the fitting. The three plungers B are then advanced simultaneously until they almost meet as shown in Fig. 2. The web left between the plungers is subsequently removed by drilling.—*May 10th*, 1923.

197,179. April 26th, 1922.—PAD BEARINGS, Entwistle and Gass, Limited, Nelson-street, Bolton; W. G. Gass and J. R. Fish, 42, Greenland-road, Great Lever, Bolton.

In this bearing the pads A A which support the shaft are mounted in the casing on semi-cylindrical supports B, which, it is claimed, ensure that the load is equally shared among the

No 197,179

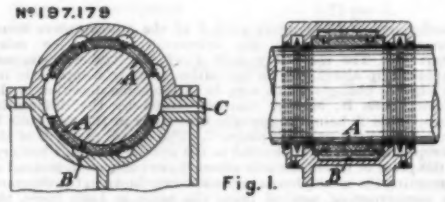


Fig. 1.

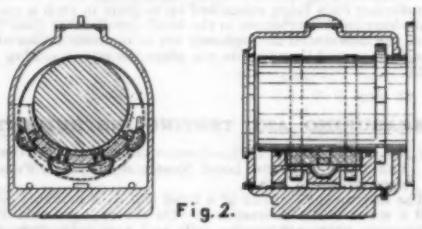


Fig. 2.

pads, as they can rock in their seatings. The arrangement also allows the pads to tilt slightly, so that the oil supplied at C can be entrained between the rubbing faces. It is suggested as an alternative that hemispherical supports should be used as shown in Fig. 2. Similar arrangements for footstep and thrust bearings are described.—*May 10th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF TRANSPORT.—Summer meeting at Sheffield. For programme see page 560.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Visit to Great Western Railway Signal Works at Reading. Leave Paddington 9.45 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Life History of an Alpha Particle from Radium," by Sir Ernest Rutherford. 9 p.m.

FRIDAY AND SATURDAY, JUNE 15TH AND 16TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—East Midland District meeting at Skegness.

SATURDAY, JUNE 16TH.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Visit to signalling installations at Wembley (Metropolitan and Great Central Railways).

TUESDAY, JUNE 19TH.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Grand Hotel, Folkestone. Summer meeting. 9.30 a.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Ordinary meeting. 3 p.m.

WEDNESDAY, JUNE 20TH.

SOCIETY OF GLASS TECHNOLOGY.—Leeds Institute, Cookridge-street, Leeds. Papers: "Specifications in the Glass Industry," by Professor W. E. S. Turner; "Notes on the Design of Pot Arches," by Mr. Th. Teisen; "Notes on the Ashley Bottle Machine," by Mr. S. English; and "The Effect of Titania on the Properties of Glass," by Mr. A. R. Sheen and Professor W. E. S. Turner. 2.30 p.m.

THURSDAY, JUNE 21ST.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper, "The British Standard Specification for Portland Cement," by Mr. D. B. Butler. 7.30 p.m.

THURSDAY AND FRIDAY, JUNE 21ST AND 22ND.

NEWCOMEN SOCIETY.—Summer meeting at Rochester.

MONDAY TO FRIDAY, JUNE 25TH TO 29TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting at Glasgow. For programme see page 615.

MONDAY TO SATURDAY, JUNE 25TH TO 30TH.

INTERNATIONAL AIR CONFERENCE.—At the Institution of Civil Engineers, Great George-street, S.W. 1. For programme see page 587.

WEDNESDAY TO SATURDAY, JUNE 27TH TO 30TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Summer meeting at Leeds. For programme see page 534.

FRIDAY, JUNE 29TH.

SOCIETE DES INGENIEURS CIVILS DE FRANCE.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "The Port of Rouen and the Lower Seine," by Monsieur M. Barillon. 8.30 p.m.

MONDAY TO WEDNESDAY, JULY 2ND TO 11TH.

INTERNATIONAL NAVIGATION CONGRESS.—At the Institution of Civil Engineers, Great George-street, S.W. 1. For programme see page 588.

TUESDAY TO SATURDAY, JULY 3RD TO 7TH.

ROYAL AGRICULTURAL SOCIETY'S SHOW at Newcastle-on-Tyne.

WEDNESDAY AND THURSDAY, JULY 4TH AND 5TH.

BRITISH WATERWORKS ASSOCIATION.—Summer meeting at Cardiff. For programme see page 565.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE "PNEULEC" MACHINE COMPANY, Limited, has just completed its new works in Mafeking-road, Smethwick. Telephone number, 444 Smethwick.

WE are informed that the board of Sir W. G. Armstrong, Whitworth and Co., Limited, has appointed Lieut.-Colonel C. F. Hitchins, D.S.O., M.I. Mech. E., general manager of the Elswick Works, Newcastle-on-Tyne.

WE are informed that the trading name of the firm of Clews, Petersen and Co., of Blackburn-road, West Hampstead, London, N.W. 6, has been changed to the Clews Petersen Piston Ring and Engineering Company, Limited.

THOMAS ROBINSON AND SON, Limited, wood-working engineers, of Rochdale, inform us that on June 20th they are moving their London offices from 79, Queen Victoria-street, E.C. 4, to Abbey House, 2, Victoria-street, Westminster, S.W. 1.

MESSRS. CLARKSON, HOOD AND CO., 45, Hope-street, Glasgow, of whom of late Mr. John A. Hood has been sole partner, have assumed Mr. A. W. Kilpatrick as a partner in the business. The name of Clarkson, Hood and Co. will be retained.

MR. GEO. W. MURRAY, who for twenty-one years was general manager of Geo. Gahagan and Co., Limited, of Bombay, has returned to this country and joined the board of J. M. Wotherspoon and Co., Limited, 6, East India-avenue, London, E.C.

IT will be remembered that the first chairman of Eversbed and Vignoles, Limited, was the late Professor W. E. Ayrton, F.R.S., who held the position till within a few months of his death in 1908. Since that date the chairmanship has remained vacant. Mr. Sydney Eversbed, who has recently retired from the position of managing director, has now accepted the office of chairman, and will, in addition, act as consultant to the company. Mr. E. B. Vignoles and Mr. A. Vines remain managing directors of the company.